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Redescription of *Leucauge fastigata* (Simon, 1877) (Araneae: Tetragnathidae) with first report of male from India

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Abstract

The genus *Leucauge* was established by White in 1841. *Leucauge fastigata* (Simon, 1877) was first reported by Simon from Philippines. Females are much larger than males, recorded from south-east Asia. Males are extremely small, reported from Burma, Sri Lanka, and Philippines so far. In the present study, detailed description and photographs of female are provided with first report of male from India.

Keywords: Araneae, Long-jawed orb weaver spiders, redescription, *Leucauge*, India.

Introduction

The family Tetragnathidae or long-jawed orb weaving spiders currently comprise 46 genera with 982 species (World Spider Catalog, 2021). This family has worldwide distribution, but highest diversity in tropical and subtropical areas of the world (Dimitrov & Hormiga, 2011). The genus *Leucauge* White, 1841 belongs to the family Tetragnathidae and consists of 182 species and subspecies. Currently, it has 11 representatives from India (World Spider Catalog, 2021). The genus has cosmopolitan distribution, characterized by silvery abdomen, the cephalothorax constricted laterally towards the cephalic area, producing a prominently broad thoracic area and truncates anteriorly, femora IV with a double fringe of hairs, epigastric plate without any furrow (Barrion & Litsinger, 1995).

In 1877, Simon described *Leucauge fastigata* as *Meta fastigata*. In 1895, Thorell reported male from Burma as *Callinethis elegans* and it was synonymized with *Argyroepeira fastigata* by Pocock in 1900. Sen *et al.* (2015) reported *L. fastigata* as *Opadometa fastigata* from India. The genus transfer was frequent because of the resemblance of somatic characters with others (Dzulhelmi *et al.*, 2015). Recently Ballesteros & Hormiga (2021) synonymized *Opadometa* with *Leucauge* based on the phylogenetic relationships within the Leucauginae.

Material and Methods

Specimens were collected by visual searching and hand picking. The collected specimens were preserved in 70% ethyl alcohol. Specimens were examined under Leica M205 C stereomicroscope. Digital images were taken by means of Leica DMC4500 digital camera attached to the stereomicroscope, with the software package Leica Application Suite (LAS), version 4.3.0. LAS montage facility. All measurements were taken in mm. Measurement data for palps and legs are as follows: total length [femur, patella, tibia, metatarsus (except palp), and tarsus]. Spination of legs (dorsal-ventral-polateral-retrolateral). Specimens are deposited in the reference collection at the Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala, India.

Abbreviations used in the text and figures are as follows: ALE = anterior lateral eye, AME = anterior median eye, C = conductor, CB = cymbium, CBP = cymbial basal apophysis, CSA = conductor secondary apophysis, E = embolus, P = paracymbium, PLE = posterior lateral eye, PME = posterior median eye, ST = subtegulum, and T = tegulum.

Taxonomy

Family **Tetragnathidae** Menge, 1866
Genus ***Leucauge*** White, 1841
Leucauge fastigata (Simon, 1877)

Diagnosis: Females are much larger than males, which are very minute. Two rows of eyes are recurved, lateral eyes closely placed and median ocular quadrangle longer than wide. Female has dense black hairs on tibia IV, which male lacks them. Both male and female have two rows of trichobothria on femur IV. Male palp is characterized by broad cymbium, long cymbial basal apophysis, and short paracymbium. The semicircular epigynal plate is located on the anterior side of the abdomen.

Material examined. 4♂♂, 5♀♀ Nilambur, Kerala, India (11°16'37"N, 76°13'33"E). Anju K. Baby, 11.10. 2021.

Description. Male (Fig. 1): Total body length 2.50. Carapace length 1.21 and width 0.88. Clypeus height 0.06. Ocular area length 0.28, width 0.25. Eye diameters: AME 0.12, ALE 0.10, PME 0.10, PLE 0.07. Length of chelicerae 0.79, width 0.33. Leg I length 4.61 (1.38, 0.31, 1.23, 1.13, 0.56), leg II 3.93 (1.22, 0.29, 0.99, 0.92, 0.51), leg III 1.78 (0.53, 0.19, 0.33, 0.43, 0.30), leg IV 2.88 (1.00, 0.26, 0.59, 0.68, 0.35). Leg formula 1243. Spination on legs: femur I (0-0-1-0), patella I (1-0-0-0), spination absent on tibia I, metatarsus I, and tarsus I. Palp total length 2.36 (1.18, 0.13, 0.45, 0.60). Abdomen length 1.29, width 0.85, height 0.42. Carapace high, yellowish brown anteriorly and pale yellow posteriorly. Both rows of eyes are recurved, surrounded by black rings, median ocular quadrangle longer than wide, lateral eyes are closely placed. Clypeus pale yellow in

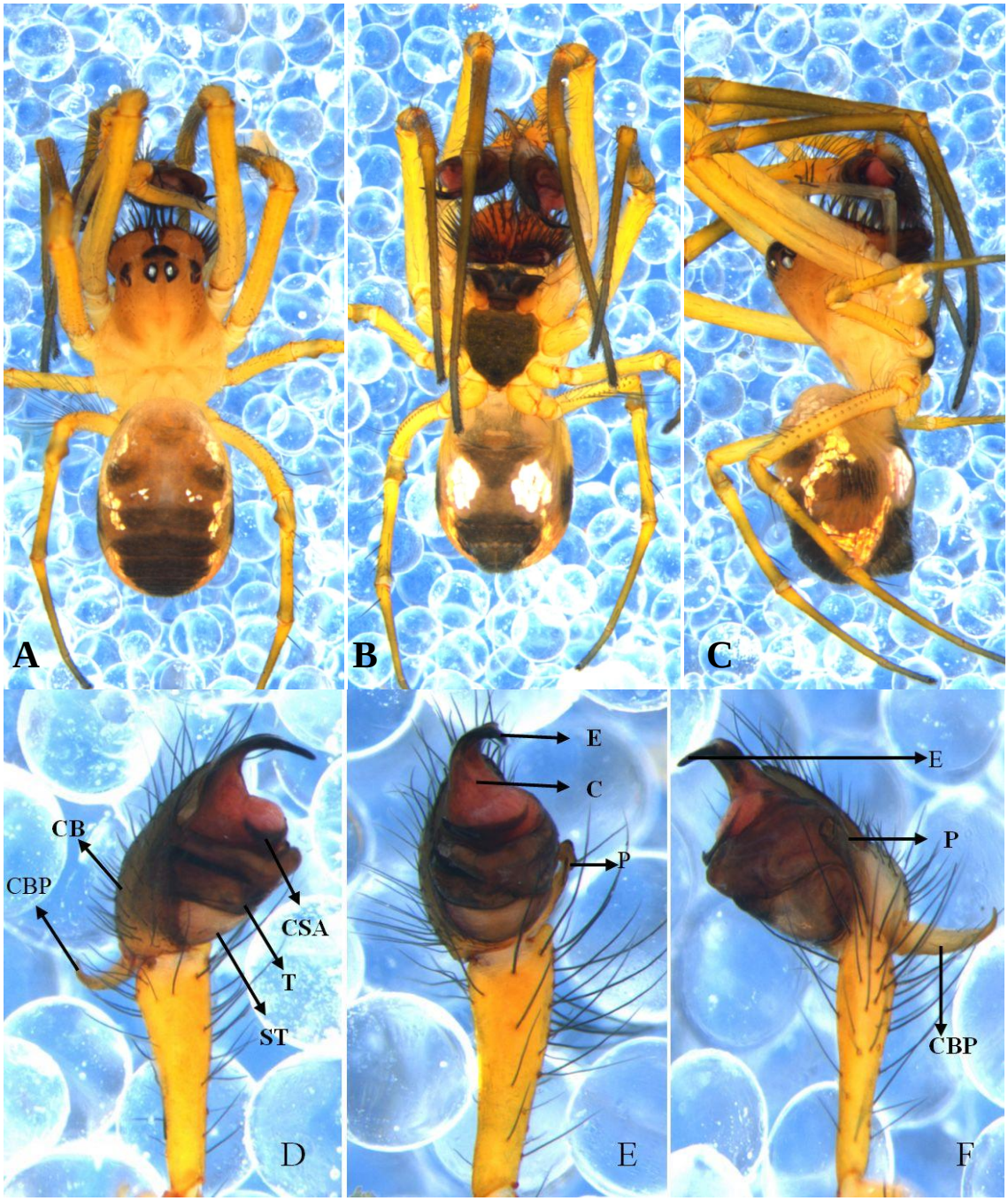

Fig. 1. *Leucauge fastigata* (Simon, 1877) ♂. A. dorsal habitus. B. ventral habitus. C. lateral habitus. D-F. Left palp. D. prolateral view. E. ventral view. F. retrolateral view.

colour. Chelicerae stout, yellowish brown with numerous black spines are present. Chelicerae with three teeth on the promargin and four teeth on the retromargin. Sternum yellowish black and heart shaped. Labium broad and yellowish brown. Maxillae long, dark brown with distinct scopulae. Legs are slender, yellow and distally brown. Ventrally, two rows of trichobothria are present on femur IV. Abdomen oval, with pale brown markings on the anterior dorsal side followed by a pair of brown patches. Two pairs of brown patches are arranged horizontally. The silvery guanine spots are present along the sides of brown patches and pale brown markings present laterally. Abdominal venter pale black with a pair of silvery guanine spots present on the middle. Spinnerets located on the posterior side of the abdomen facing downwards. Palp has broad cymbium.

CBP long, slender and distally projected upward. Paracymbium broad at the base, overlapping the tegulam and somewhat bulbous distally. CSA long, dark and distally tapering. Conductor broad basally, gradually narrowed and curved. Embolus overlapping the conductor (Figs. 1D-F).

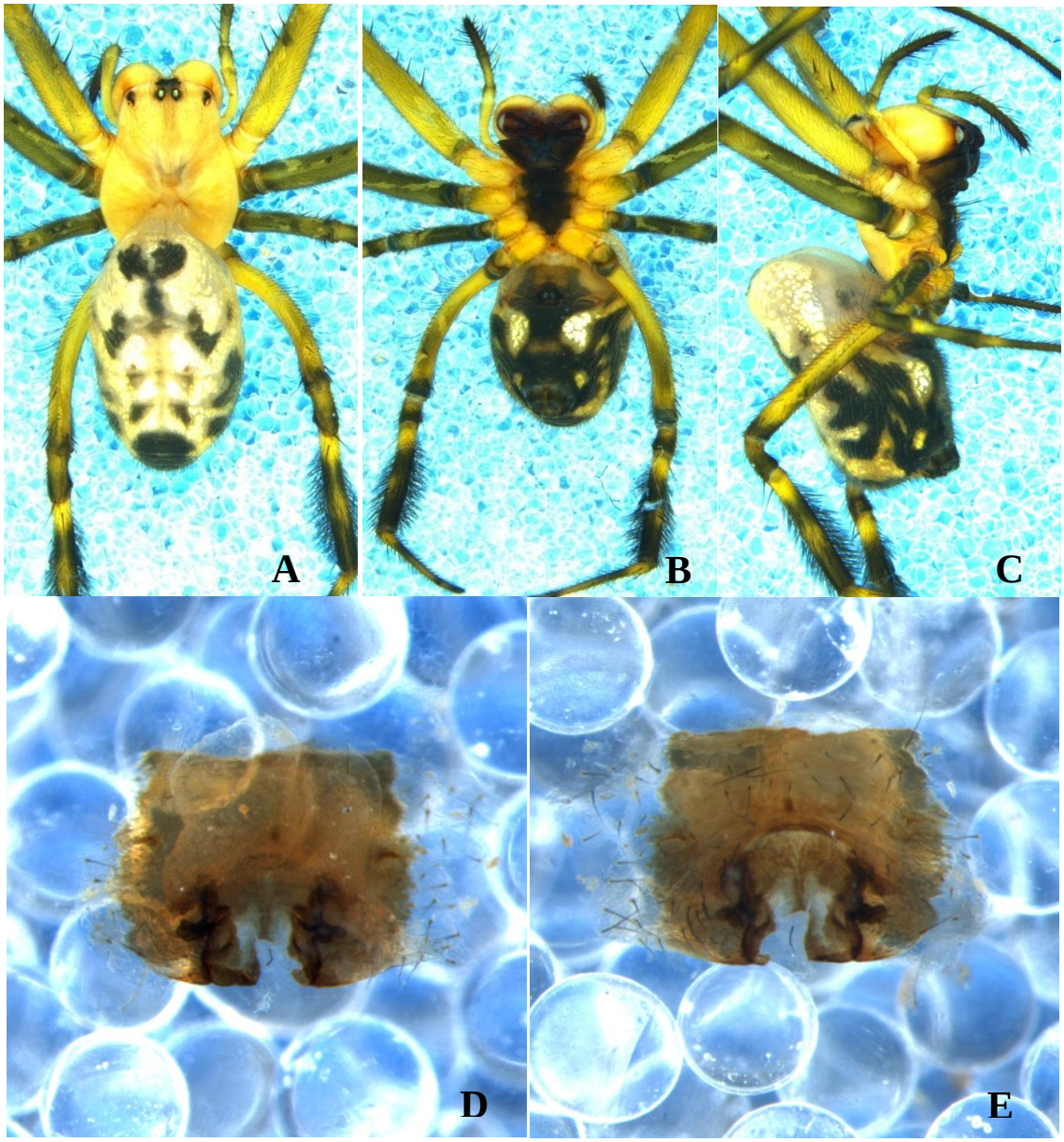

Fig. 2. *Leucauge fastigata* (Simon, 1877) ♀. A. dorsal habitus. B. ventral habitus. C. lateral habitus. D-E. Epigyne. D. dorsal view. E. ventral view.

Female (Fig. 2). Total body length 9.33. Carapace length 3.50 and width 2.55. Clypeus height 0.18. Ocular area length 0.50, width 0.40. Eye diameters: AME 0.18, ALE 0.18, PME 0.17, PLE 0.13. Length of chelicerae 1.90, width 1.01. Leg I length 17.23 (5.12, 1.10, 4.55, 4.98, 1.48), leg II 16.88 (4.80, 1.08, 4.53, 5.04, 1.43), leg III 7.25 (2.45, 0.60, 1.46, 1.89, 0.85), leg IV 12.58 (4.32, 0.76, 2.83, 3.50, 1.17). Leg formula 1243. Spination on legs: femur I (0-0-3-3), patella I-IV (1-0-0-0), tibia I (3-0-3-2), metatarsus I (0-0-1-0), and absent on tarsus I. Abdomen length 5.83, width 3.66, height 2.66. Carapace flat, yellow, anteriorly narrowed and medially broad. Both rows of eyes are recurved,

surrounded by black rings, median ocular quadrangle longer than wide, lateral eyes closely placed. Clypeus yellow. Chelicerae stout, yellow at the base and brownish yellow distally. Chelicerae with three promarginal teeth and four retromarginal teeth. Sternum black, heart shaped, labium broad and yellowish brown. Maxillae long, dark brown with distinct scopulae. Legs are robust, olive green with yellow markings. They have two rows of trichobothria on femur IV and dense black hairs on tibia IV. Abdomen narrowed anteriorly and blunt shoulder humps strongly overhanging the cephalothorax. The dorsum of the abdomen with prominent black markings and guanine spots. Abdominal venter dark with two pairs of bright guanine spots on the middle. Epigynal plate flat, dark and semicircular. Copulatory duct sclerotized, strongly folded medially with large inflated balloon like spermathecae (Figs. 2D-E).

Natural History. Diurnal in habit. They make large horizontal orb webs in open areas between trees and other large vegetations. They usually build orb webs more than one metre from the ground in humid regions of primary and secondary forests. During the day time, they rest on the centre of the web usually facing downwards. They can be easily observed by their colourful, attractive appearance.

Distribution. Indonesia, Malaysia, Philippines, India, Singapore, Thailand.

Discussion

In 1877, Simon originally described *Leucauge fastigata* on the basis of female, but his description lacks proper illustrations of somatic and genitalic characters. Most of the descriptions of females are without proper genitalic information. Detailed examination of female shows that they are characterized by the presence of dense hairs on tibia IV, strongly folded copulatory duct and large spermathecae. Thorell (1895) described the male of this species collected from Burma without illustrations. Archer (1951) mentioned that males of *Opadometa* are "extremely diminutive". Detailed examination of male shows that palp has long femur, tibia, short paracymbium, and embolus is overlapping the conductor. Male has spinous chelicerae and femur IV with two rows of trichobothria.

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A new lynx spider of genus *Oxyopes* Latreille, 1804 from India (Araneae: Oxyopidae)

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Abstract

The current paper gives the first descriptive report of the male of *Oxyopes kolkhasensis* sp. nov. from India. The new species closely resembles *O. bharatae* Gajbe, 1999, but it is distinguished from it based on a slender, thinner and anteriorly pointed cymbial ending along with a more procurved and posteriorly pointed cymbial spur as well as a smaller ventral tibial apophysis. Detailed taxonomic inputs supporting the novel species are presented.

Keywords: lynx spider, *Oxyopes kolkhasensis*, Melghat, India.

Introduction

Oxyopidae Thorell, 1869, commonly known as lynx spiders, is a fairly small family hosting 9 genera and 442 species (World Spider Catalog, 2021). These small to large sized spiders are distinguished by three tarsal claws, prominent setae on legs, and four distinct rows of eyes (2-2-2-2), mainly inhabiting panicles of plants, leaves of the grasses and on other weeds found along field margins (Zhang & Zhu, 2005). The type genus *Oxyopes* established by Latreille in 1804 had its first Indian subcontinent species recorded in by Walckenaer (1805). The genus represents a diverse group with global distribution. Of the 290 recorded *Oxyopes* species, 55 are recorded from India (World Spider Catalog, 2021). The distinguishing characters of the genus are the almost vertical face, long and distally narrowing chelicerae with short fangs, with one tooth on both

anterior and posterior cheliceral margins. Abdomen is elongate, with spiny legs. Metatarsi are shorter than Patella-Tibia, with few exceptions (Gajbe, 2008).

The current paper gives the first descriptive report of the male *Oxyopes kolkhasensis* sp. nov. reported from the Kolkhas region of Melghat Tiger Reserve, Maharashtra, India.

Material and Methods

The reported specimen was collected from the Kolkhas region of Melghat Tiger Reserve, Dist. Amravati, Maharashtra by sweep netting method from a grassland vegetation patch. The collecting area is located near the government guest house close to the banks of Sipna river. The samples were preserved in 70% alcohol and deposited in the Spider Research Laboratory (SR Lab), J. D. Patil Sangludkar Mahavidyalaya, Daryapur.

Morphological observations and photography were taken with Olympus SZ61 microscope and SL Image 2013 software respectively. Body measurements were taken with Zeiss Stemi 2000-C microscope and ZEN 2011 software. Male genitalia were dissected and treated in 10% KOH for further analysis. All measurements are given in millimetres.

Abbreviations used in the text are as follows: ALE = anterior lateral eye, ALS = anterior lateral spinnerets, AME = anterior median eye, d = dorsal, Fe = femur, Mt = metatarsus, Pa = patella, pl = prolateral, PLE = posterior lateral eye, PLS = posterior lateral spinnerets, PME = posterior median eye, PMS = posterior median spinnerets, rl = retrolateral, RTA = retrolateral tibial apophysis, Ta = tarsus, Ti = tibia, v = ventral, VTA = ventral tibial apophysis.

Results

Oxyopes kolkhasensis sp. nov. (Figs. 1-6)
Material examined: 1♂ (Holotype) from Kolkhas region of Melghat Tiger Reserve, Dist. Amravati, Maharashtra, India, collected on 2 October 2015 by Atul K. Bodkhe and Subhash S. Kamble.

Etymology: The specific name refers to the place of sample collecting.

Diagnosis: Male of *Oxyopes kolkhasensis* sp. nov. closely resembles *Oxyopes bharatae* Gajbe, 1999 but differs from it as follows: (i) a pair of prominent concave longitudinal bands running from AME up till the length of chelicerae but in *O. bharatae* such bands are absent, rather four thick longitudinal stripes extend from PME and PLE to posterior end of carapace, (ii) abdomen has several skin folds with no distinct colouration, whereas in *O. bharatae* abdomen has a dark orange band running longitudinally and mid-dorsally, (iii) palp differs from *O. bharatae* in having a VTA larger than RTA, a broad and flat median apophysis and a conductor longer than the embolus (Gajbe, 1999, 2008). It also differs from *O. chittrae* Tikader, 1965 in having a more slender, thinner and anteriorly pointed cymbial ending as compared to a broader one in *O. chittrae* as ventrally seen. It also has a more procurved and posteriorly pointed cymbial spur as well as a smaller VTA as compared to *O. chittrae* which has a blunt and almost rounded spur tip. The dorsal morphological patterns also differ (Tikader, 1965).

Description. Total body length 5.77; Cephalothorax length 2.45, width 1.97; Abdomen length 3.32, width 1.06; Sternum length 1.05, width 0.99. AME 0.07, ALE 0.18, PLE 0.16, PME 0.17. Distances between eyes AME-ALE 0.05, ALE-PLE 0.13, PLE-PME

0.19. Eye diameter: ALE 0.18, AME 0.15, PME 0.11, PLE 0.85. Endite length 0.64, Labium length 0.37.

Cephalothorax: longer than wide, yellowish orange, smooth, slightly raised around the ocular region, with pubescence present around the fovea and the posterior part of carapace and also around the eyes. Two conspicuous concave shaped longitudinal bands run from the AME up till the length of the chelicerae but end shortly before it. The lateral apices of the base of chelicerae light brown. Fovea deep and prominent. Inconspicuous white stripes radiate from the fovea till the lateral parts of the carapace. Ocular area hexagonal, slightly wider than long, with the presence of fine white hairs around the hexagon. Sternum somewhat heart shaped, slightly longer than wide, yellow and pointed at the posterior tip. Sternum smooth with presence of very few setae anteriorly and mid laterally. Sternum margin wavy in shape. Third and fourth coxae having a pair of basal sclerites. Second pair of coxae having single basal sclerite. First pair of coxae having few setae, rest having fine pubescence of the margins. Chelicerae long, yellowish orange, covered by microsetae, possessing one pair of promarginal teeth. Endites longer than wide, strong with brown anterior tip. The anterior tip of maxillae having fine pubescence along with setae on the retrolateral margins. Labium longer than wide, yellow, clothed in fine hair and microsetae. Posterior base of labium having brown clusters of hair on the lateral margins. Fangs short, yellowish brown, hairy in appearance with clusters of white hair around the fang tip. Eight eyes, all black. AME smallest, strongly procurved and forming a separate row. The ALE, PME and PLE placed in the shape of a hexagon. PME recurved. All eyes have a distinct black rim around them along with pubescence.

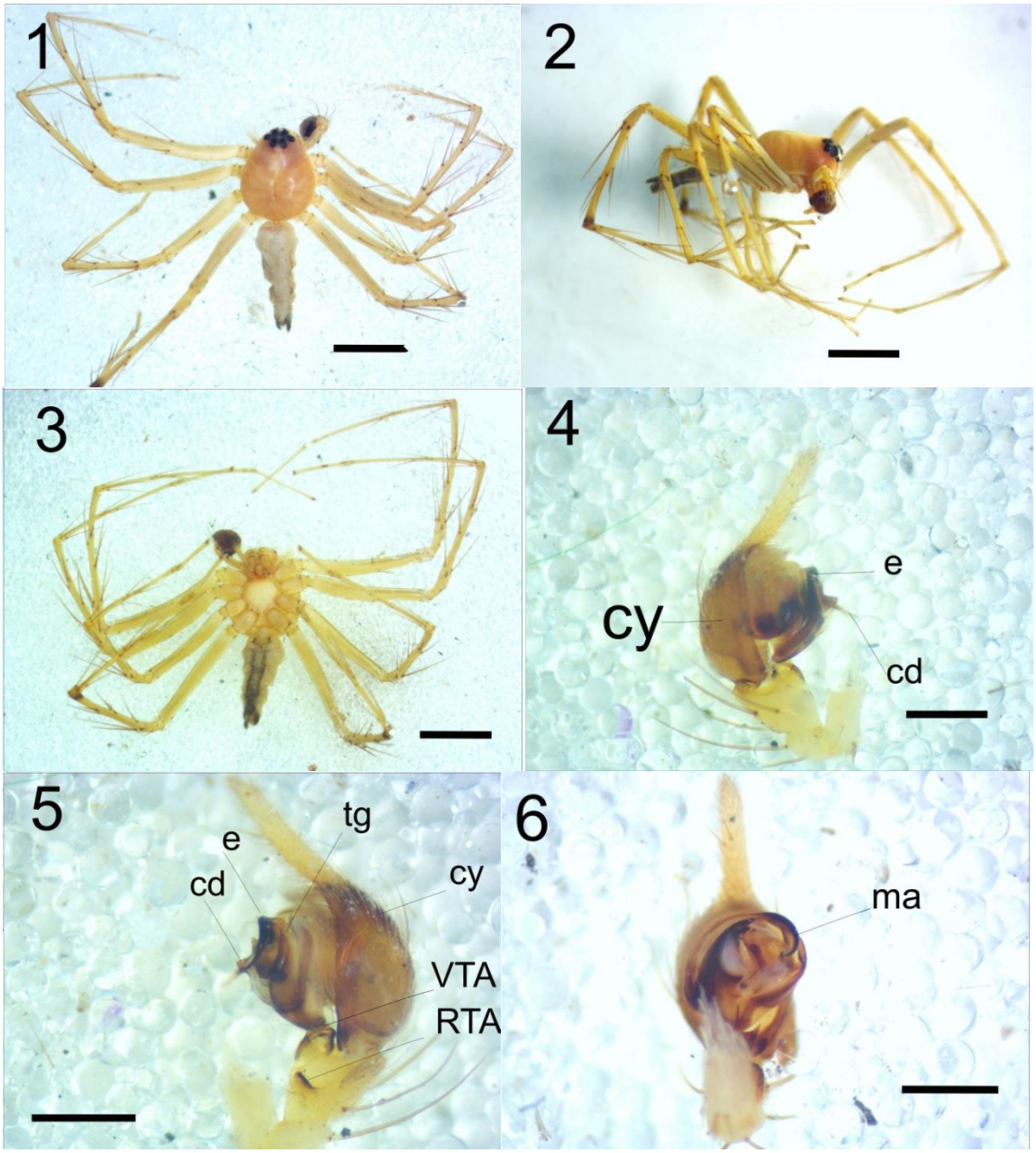
Abdomen: longer than wide, dirty whitish, with no conspicuous colouration and a gradually narrowing posterior tip. Two black bands run along the lateral edges of the abdomen, discontinuous in the median region, and meets near the posterior tip before the spinnerets; clothed in fine hairs that are darker and more aggregated near the posterior tip. Presence of a few scanty, short and stiff hairs near the anterior and posterior ends. Abdomen having multiple skin fold, some overlapping the others. Ventral side lighter in colour than dorsal with two mid-ventral olive-green longitudinal bands originating just below the epigastric furrow and running till the spinnerets. Discontinuous patches of similar colour running longitudinally between the stripes. Presence of skin folds in the median and posterior region. Posterior skin folds multiple and almost overlapping. Posterior lateral spinnerets largest, without colulus and darker in shade compares to PMS and ALS. PMS almost hidden between PLS and ALS. PLS darker in colour and hairier compared to PMS and ALS.

Table 1. Leg measurements (mm) of *Oxyopes kolkhasensis* sp. nov. ♂.

Leg	**Fe**	**Pa**	**Ti**	**Mt**	**Ta**	**Total length**
I	3.58	0.87	4.01	4.12	1.94	14.52
II	3.06	0.92	3.46	3.69	1.39	12.52
III	2.57	0.79	2.45	2.92	1.15	9.88
IV	2.94	0.84	3.14	4.04	1.38	12.34

Legs: long, strong and covered with conspicuous spines; yellowish orange with a thin black band running on the prolateral margin of the femur on every leg. Every leg has

three tarsal claws. Leg measurements are given in Table (1). Leg formula: 1-2-4-3. Leg spination is given in Table (2).



Figs. 1-6. *Oxyopes kolkhasensis* sp. nov. ♂. 1-3. Habitus. 1. dorsal view. 2. lateral view. 3. ventral view. 4-6. Palp. 4. prolateral view. 5. retrolateral view. 6. ventral view. [Abbreviations: cd = conductor, cy = cymbium, e = embolus, ma = median apophysis, RTA = retro-tibial apophysis, tg = tegulum, VTA = ventro-tibial apophysis]
Scale bars: 1,3 (2.01 mm), 2 (2.0 mm), 4-6 (0.50 mm).

Palp: Tibia with an RTA and a VTA. RTA small, slightly projecting proventrally. VTA near the anterior tip of tarsus procurved into a blunt pointed tip. Three spines on tibia and two on the patella. Cymbium has two dorsal spines and two ventral spines. Embolus long, originates from 12 o'clock position of the palpal bulb, shaped like a laterally inverted "C", runs anti-clockwise and ends medially on the same longitudinal plane. Median

apophysis broad, flat and anteriorly oval shaped with rough edges. Conductor broad, runs close to the embolus and extending beyond it.

Table 2. Spination of legs of *Oxyopes kolkhasensis* sp. nov. ♂.

	Leg I	**Leg II**	**Leg III**	**Leg IV**
Fe	d=5, rl=3, v=1	d=4, rl=3, pl=2, v=1	d=4, rl=1, v=1	d=3, rl=2, v=1
Pa	rl=2	d=3, rl=1	d=2, pl=1	d=1, rl=1
Ti	d=2, rl=1, pl=1, v=3	d=3, rl=2, pl=3, v=3	d=2, rl=3, pl=2, v=3	d=3, rl=1, pl=2, v=2
Mt	d=3, rl=1, pl=2	d=6, rl=1, pl=4	d=4, rl=1, pl=3	d=4, rl=1, pl=3

Type locality: *Oxyopes kolkhasensis* sp. nov. was found in a grassland patch, along a leaf blade, in close proximity to a water body, Sipna River. As is established for the genus, it preferred open grassy habitats with well-spaced leaf blades.

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First record of *Theridion hotanense* Zhu & Zhou, 1993 (Araneae: Theridiidae) from India

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Abstract

Theridion Walckenaer, 1805 is the most spider rich genus of Family Theridiidae. So far, 585 species, and subspecies, of the genus *Theridion* have been recorded from various parts of the world. *Theridion hotanense* Zhu & Zhou, 1993 is described for the first time from India. Digital photographs are used to redescribe the species.

Keywords: Comb-footed spider, Cheruthoni, Idukki, Kerala, first record, taxonomy, India.

Introduction

Comb-footed spiders, Family Theridiidae Sundevall, 1833, are one of the most well-known spider families, with 2538 species divided into 125 genera (World Spider Catalog, 2021). Despite the fact that India's climate and topography may support a diverse assemblage of theridiid spiders, research on Family Theridiidae is limited in India.

Even though *Theridion* Walckenaer, 1805 is the most diverse genus of the family, only 10 *Theridion* species are reported from India so far (Caleb & Sankaran, 2021). During our study of Kerala's Comb-footed spiders, we came across a female of *Theridion hotanense* Zhu & Zhou, 1993. We present the first record of *Theridion hotanense* from India in this paper. The present species was collected from the Cheruthoni region of Idukki, a district of Kerala located in the Western Ghats.

Material and Methods

The spider was collected by hand collecting method. The specimen was studied under a LEICA SAP0 stereomicroscope. All measurements are in millimetres. Leg measurements are given as: Total, Femur, Patella, Tibia, Metatarsus (except palp), and Tarsus. The microphotographic images were taken by a Leica FLEXACAM C1 digital camera attached to a LEICA SAP0 stereomicroscope with the software package Leica Application Suite X (LAS X). The specimen was deposited in a reference collection housed at the Department of Arachnology, Department of Zoology, Deva Matha College, Kuravilangad, Kottayam, Kerala, India (DMCK).

The identification of the species depended on: Song *et al.* (1999), Zhu & Zhou (1993), and Zhu (1998).

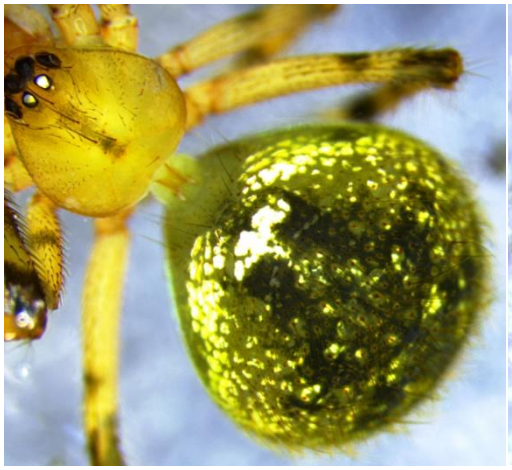
Abbreviations used in the text: AL = abdomen length, ALE = anterior lateral eye, AME = anterior median eye, CL = carapace length, DMCK TH = Deva Matha College Kuravilangad Theridiidae, L = length, PLE = posterior lateral eye, PME = posterior median eye, W = width.

Taxonomy

Family **Theridiidae** Sundevall, 1833
Genus ***Theridion*** Walckenaer, 1805
Theridion hotanense Zhu & Zhou, 1993

Diagnosis: Female of *Theridion hotanense* Zhu & Zhou, 1993 is similar to *Theridion varians* Hahn, 1833, these species shares similar markings in cephalothorax, eye arrangement, oval spermathecae that are separated half of its diameter and twisted copulatory duct. However, *Theridion hotanense* Zhu & Zhou, 1993 can be distinguished from *Theridion varians* Hahn, 1833 by the absence of a dark triangular lip at the anterior portion of atrium (Almquist, 2005).

Redescription of female (DMCK TH-077; Figs. 1-5) 1♀ is collected from Cheruthoni (Idukki, Kerala, India), by Reshmi Sekhar on 17 January 2021. Overall colour is greenish yellow, with white and black patterns on the abdomen. Total length (CL+AL) 3.93; Carapace L 1.60, W 1.42; Abdomen L 2.33, W 2.31. A "Ψ" shaped marking is seen at the middle of the cephalothorax. The area around the eyes is elevated, with little hair. Except PME (pearly white), all other eyes are black in colour. Eye rims present. Eye diameter: AME 0.47, ALE 0.52, PME 0.56, PLE 0.53. Distance between eyes: AME-AME 0.53; PME-PME 0.49; AME-PME 0.26, AME-ALE 0.32. Lateral eyes are closely placed. Maxillae and labium are brownish. Sternum triangular, brownish bordered, narrowing posteriorly, covered with fine hair. The legs are long and thin, yellow with greenish-black patches. Measurements of palp and legs: Palp 1.00 (0.36, 0.07, 0.31, 0.26); Leg I 11.39 (3.66, 0.72, 2.88, 3.08, 1.05), II 8.70 (2.23, 0.41, 2.51, 2.75, 0.80), III 8.76 (3.12, 0.23, 2.34, 2.56, 0.51), IV 10.61 (3.45, 0.56, 2.67, 2.98, 0.95). Leg formula: 1432. White, greenish-yellow, and blackish green patterns cover the abdomen. Greenish-yellow with white patches in the ventral region. Spinnerets are well developed. Epigyne with a pair of oval spermathecae that are half the distance apart; twisted copulatory ducts (Fig. 5).
Habitat. The spider was found inside a leaf retreat.
Distribution: China, Iran (World Spider Catalog, 2021) and India (Present record).



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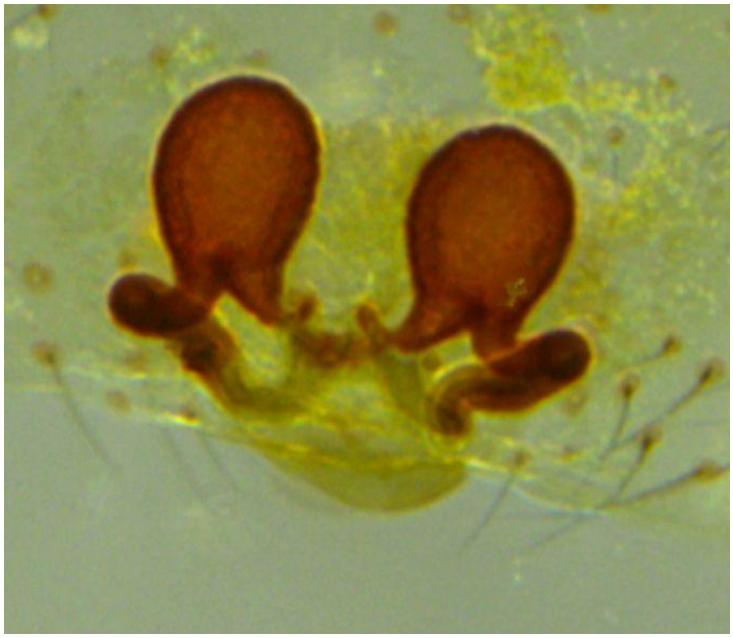

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Figs. 1-5. *Theridion hotanense* Zhu & Zhou, 1993 ♀ (DMCKTH-077). 1-3. Habitus. 1. dorsal view. 2. ventral view. 3. lateral view. 4. eyes. 5. vulvae, dorsal view.

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The first record of *Minosiella pallida* (L. Koch, 1875) (Araneae: Gnaphosidae) in Egypt

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Abstract

The gnaphosid spider species *Minosiella pallida* (L. Koch, 1875) is recorded for the first time from Egypt. Its general habitus and genitalia of both male and female are illustrated. Notes on the description, habitat, and collecting data of this species are also given.

Keywords: Araneae, Gnaphosidae, *Minosiella pallida*, new record, Egypt.

Introduction

Among the 164 genera of family Gnaphosidae Banks, 1892 (2576 species), genus *Minosiella* Dalmas, 1921 is a small gnaphosid genus with only 7 species (World Spider Catalog, 2021). A century ago, Comte de Dalmas described genus *Minosiella* with other new genera and species of family Gnaphosidae (Dalmas, 1921).

Family Gnaphosidae is represented in the Egyptian fauna by 51 species of 23 genera; it is the second big family of spiders in Egypt after Salticidae and before Lycosidae (El-Hennawy, 2017; El-Hennawy *et al.*, 2020).

Genus *Minosiella* is represented in Egypt by two species (El-Hennawy, 2017):
Minosiella mediocris Dalmas, 1921 --- Cairo, El-Fayum, Siwa Oasis, Suez
Minosiella pharia Dalmas, 1921 --- Cairo

Here, we present the new record of *Minosiella pallida* (L. Koch, 1875) from Serabium region, Ismailia governorate, Egypt.

Material and Methods

The study area, Serabium forest, about 16 km south of Ismailia, was established in 1998 and its cultivation process began in 2002 with 16 introduced tree species over nearly 600 feddans (Fig. 1). All productive trees were cultivated as patches of monoculture canopies. It is a part of the national Egyptian programme for safe use of treated sewage water for afforestation project to develop an innovative afforestation approach using water unsuitable for human direct or indirect consumption on unproductive land (Medany, 2013).

These tree canopies with their accumulated litter attracted insects and their predators of spiders and other arthropods. Hence, spiders were studied in woody forest plantation in Serabium region, Ismailia governorate, as bioindicator for environmental risk assessment by Doaa Medany (2013). That study included 3217 individuals of 106 spider species that belong to 58 genera and 26 families, collected from only six canopy species.

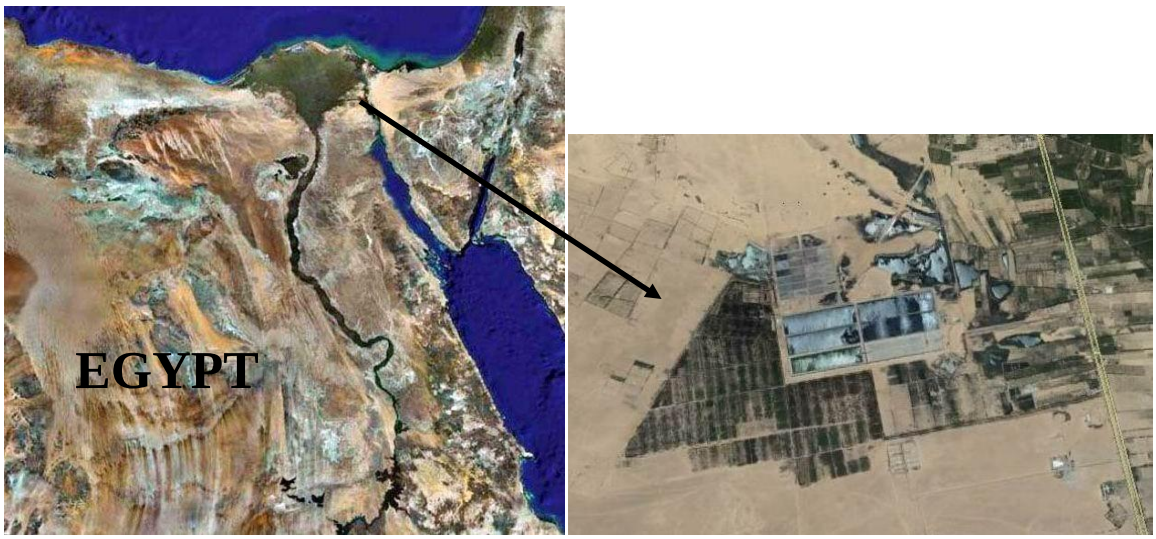


Fig. 1. Collecting site in Serabium region beside the sewage treatment station of Ismailia, Egypt.

The most species-rich family was Gnaphosidae (17 species) that was the most abundant and diverse family in the forest habitat too. During this study, five spider species were newly recorded in Egypt (Medany, 2013; El-Hennawy *et al.*, 2012; El-Hennawy, 2017), two of them are gnaphosids: *Micaria dives* (Lucas, 1846) and *Odontodrassus aravaensis* Levy, 1999. Hence, Serabium forest looks promising to look for spiders among its trees. Later, as a result of new collecting activity in the same region, *Zelotes tragicus* (O. Pickard-Cambridge, 1872) was recorded too (El-Hennawy *et al.*, 2020).

In this new study, another gnaphosid species is recorded for the first time in Egypt. It was found only in the areas of two kinds of trees:

1- *Corymbia citriodora* (Hooker, 1848) Hill & Johnson, 1995 commonly known as lemon-scented gum or spotted gum [كافور ليمونى] (Fig. 2A).

2- *Cupressus sempervirens* L. commonly known as the Mediterranean cypress [سرو] (Fig. 2B).

A   B

Fig. 2. Trees cultivated in Serabium region near the sewage treatment station of Ismailia. A. Lemon-scented gum *Corymbia citriodora*. B. *Cupressus sempervirens*.
(After Medany, 2013: 42, 47)

Collecting spiders was done mostly by hand (Hand collecting) and sometimes by pitfall traps (Pitfall trapping), once a month, during the period from January to October 2019, preceded by two preliminary trips in July and September 2018. Pitfall traps were only used in March and April 2019. The newly recorded gnaphosid species was collected by hand only.

Abbreviations used: AL = abdomen length, CL = cephalothorax length, CW = cephalothorax width, d = dorsal, Fe = femur, Mt = metatarsus, Pa = patella, pl = prolateral, rl = retrolateral, Ta = tarsus, Ti = tibia, TL = total length, v = ventral.

All measurements were taken in millimetres.

Results

Among the spiders collected from Serabium forest near the sewage treatment station of Ismailia during monthly trips from December 2018 to October 2019, spiders of different genera of family Gnaphosidae were well represented. *Minosiella pallida* (L. Koch, 1875) spiders were found in December 2018 and July 2019 in litter below and among the trees of *Corymbia citriodora* and *Cupressus sempervirens*, respectively.

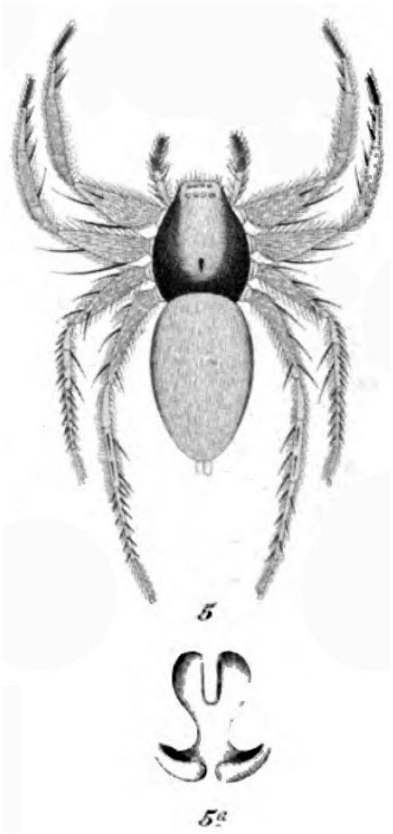
Family **Gnaphosidae** Banks, 1892
Genus ***Minosiella*** Dalmas, 1921

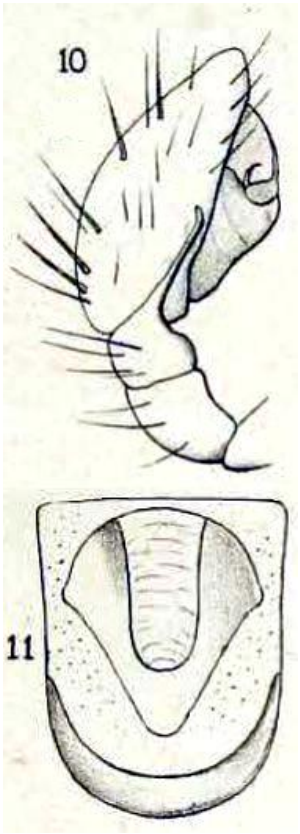
Minosiella pallida (L. Koch, 1875)
(Figs. 3-15)

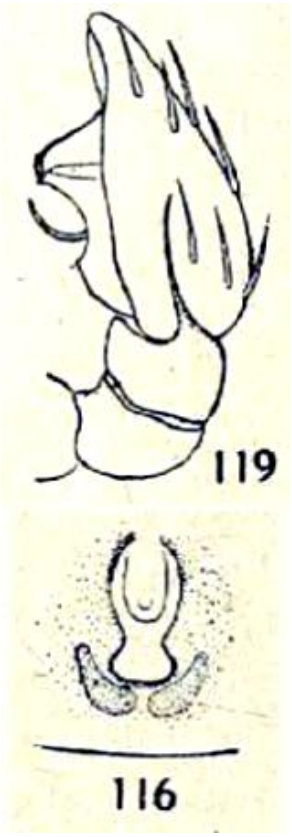
Gnaphosa pallida L. Koch, 1875: 42-43, pl. 4, f. 5 (D♀).
Pythonissa arenicolor Simon, 1882: 237-238, pl. 8, f. 10-11 (D♂♀).
Minosiella pallida Dalmas, 1921: 313-314, f. 116, 119 (♂♀).

Material examined: 2♀♀, 9 December 2018, among *Corymbia citriodora* trees; 2♂♂, 5♀♀, 30 July 2019, among *Cupressus sempervirens* trees. Egypt, Ismailia governorate, Ismailia (about 30°29'27"N, 32°14'29"E, elevation 10 m). Collected by Gihan Sallam, Nahla Abd El-Azim & Hazem Abul Fadl.

Description: This species was described in detail, with variations, by L. Koch (1875), Simon (1882), and Dalmas (1921). The figures published by those three authors, especially Dalmas (1921), helped in identification (Figs. 3-5).







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Figs. 3-5. Figures of *Minosiella pallida* (L. Koch, 1875) in old literature.
3. *Gnaphosa pallida* L. Koch (1875): pl. 4, f. 5, 5a.
4. *Pythonissa arenicolor* Simon (1882): pl. 8, f. 10-11.
5. *Minosiella pallida* Dalmas (1921): f. 116, 119.
[5. habitus, dorsal view, ♀. 10, 119. ♂ palp. 5a, 11, 116. ♀ epigynum.]

Male (Fig. 6)**:** measurements (n=2): TL 3.6-4.7 [including spinnerets], CL 1.9-2.2, CW 1.4-1.7, AL 1.6-2.5, CL/CW ~ 1.32. Measurements of leg segments (Table 1).

Female (Fig. 7)**:** measurements (n=5): TL 5.2-5.9 [including spinnerets], Average TL 5.6, CL 2.4, CW 1.8, AL 2.7, and 2 bigger specimens TL 6.4, CL 2.6-2.9, CW 2-2.2, AL 3.5-3.8. CL/CW ~ 1.34. Measurements of leg segments (Table 2).

Table 1**.** Measurements of leg segments of *Minosiella pallida* ♂.

Legs	Fe	Pa	Ti	Mt	Ta	TL
I	1.5	0.7	1.1	0.7	0.6	4.6
II	1.4	0.7	0.9	0.8	0.6	4.4
III	1.4	0.6	0.7	0.7	0.7	4.1
IV	1.5	0.8	1.2	1.5	0.8	5.8

Leg formula: ♂ 4-1-2-3, ♀ 4-2-1-3.

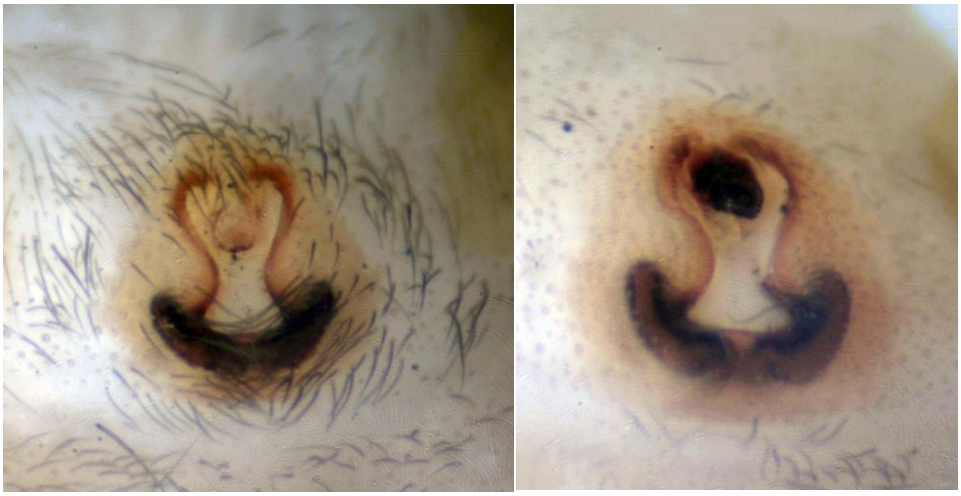
6   7

Figs. 6-7. *Minosiella pallida* (L. Koch, 1875), habitus, dorsal view. 6. ♂. 7. ♀.

8   9

10   11

Figs. 8-11. *Minosiella pallida* (L. Koch, 1875), ♂ left palp.
8-9. retrolateral view. 10. prolateral view. 11. ventral view.



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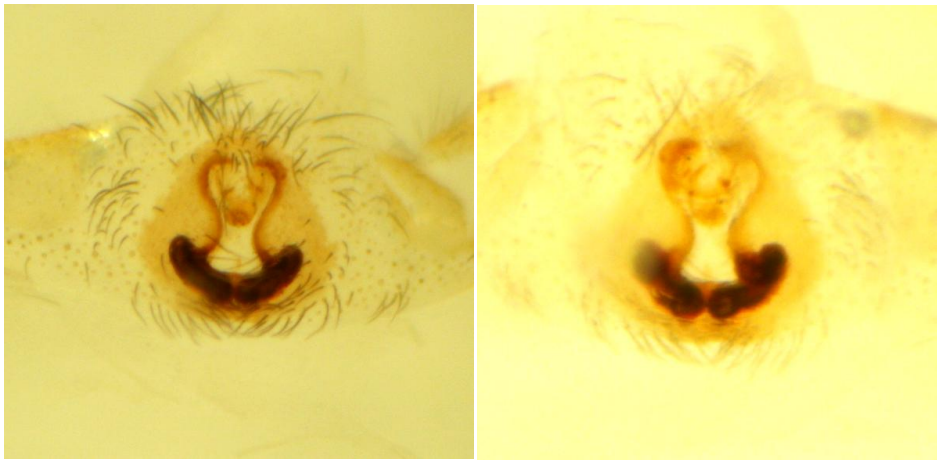

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Figs. 12-15. *Minosiella pallida* (L. Koch, 1875), ♀. 12-14. Epigynum, ventral view. 15. Vulvae, dorsal view. 14-15. cleared.

Table 2**.** Measurements of leg segments of *Minosiella pallida* ♀.

Legs	Fe	Pa	Ti	Mt	Ta	TL
I	1.3	0.7	0.9	0.6	0.6	4.1
II	1.3	0.7	0.9	0.7	0.6	4.2
III	1.3	0.5	0.7	0.9	0.7	4.1
IV	1.7	0.7	1.1	1.3	0.7	5.5

Leg spination (♂):
Femora: I – d 1-1-0; II – d 1-1-0; III – d 1-1-2; IV – d 1-1-2. Patellae: III – *numerous*.
Tibiae: I – v 1-2-0; II – pl 0-0-1, v 1-1-1; III – *numerous*; IV – pl 1-1-1, rl 1-1-0, v 2-2-2.
Metatarsi: I – v 2-0-0; II – v 2-0-2; III – *numerous*; IV – pl 1-1-1, rl 1-1-0, v 2-2-2.

Leg spination (♀):
Femora: I – d 1-1-0, rl 0-0-1; II – d 1-1-0, rl 0-0-1; III – d 1-1-1, , pl 0-1-0; IV – d 1-1-2.
Tibiae: II – rl 0-0-1, v 1-1-0; III – *numerous*; IV – pl 0-1-1, rl 0-1-1, v 1-1-1.
Metatarsi: II – v 2-0-0; III – *numerous*; IV – pl 0-1-1, rl 0-1-1, v 1-1-1.

Male palp as in Figs. (8-11).
Female epigynum as in Figs. (12-15).

Distribution: Eritrea, Djibouti, Yemen, Oman, Pakistan (Fig. 16), Egypt "NEW RECORD" (Fig. 17).

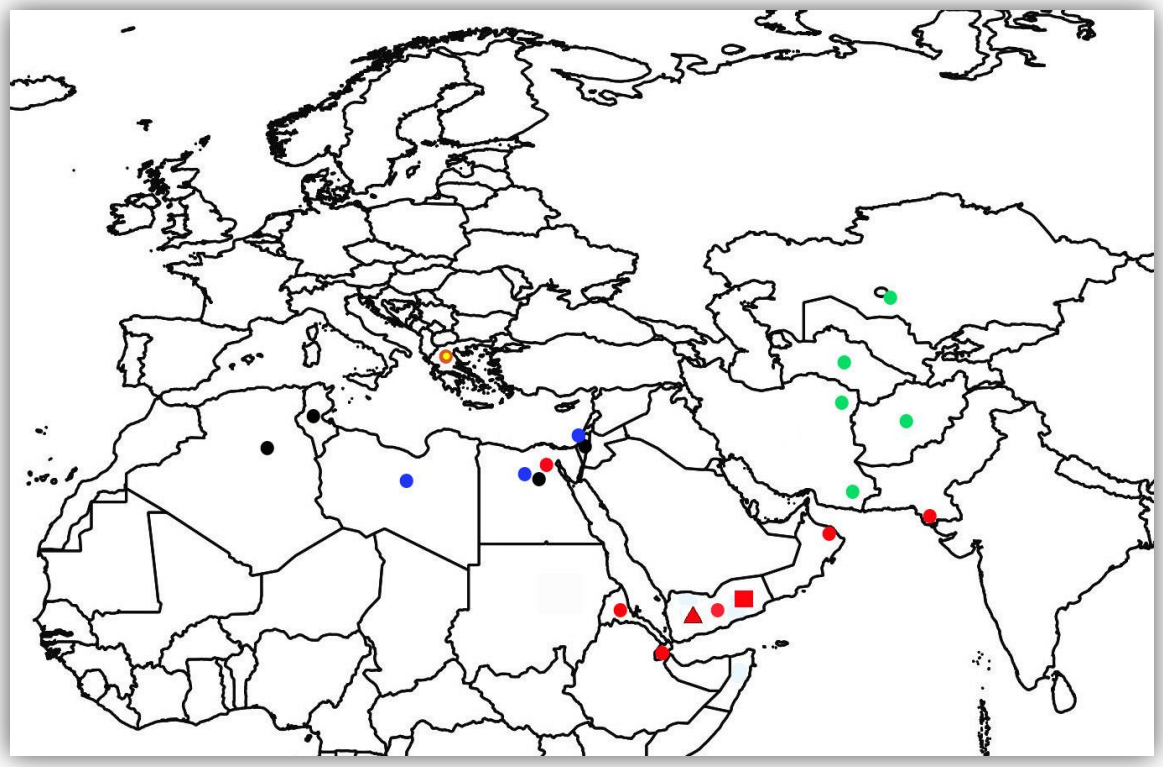

Fig. 16. Distribution map of *Minosiella* species in Africa, Asia, and Europe.

= *Minosiella apolakia* Chatzaki, 2019 Greece
= *Minosiella intermedia* Denis, 1958 Iran, Afghanistan, Turkmenistan, Aral Sea
= *Minosiella mediocris* Dalmas, 1921 Algeria, Tunisia, Egypt, Palestine/Israel
= *Minosiella pallida* (L. Koch, 1875) Egypt, Eritrea, Djibouti, Yemen, Oman, Pakistan
= *Minosiella perimensis* Dalmas, 1921 Yemen
= *Minosiella pharia* Dalmas, 1921 Egypt, Libya (?), Palestine/Israel
= *Minosiella spinigera* (Simon, 1882) Yemen

Minosiella apolakia Chatzaki, 2019 Greece [Rhodes, Karpathos](Chatzaki & Van Keer, 2019).

Minosiella intermedia Denis, 1958 Afghanistan [Pirzada (environs of Kandahar)](Denis, 1958); Iran [Razavi Khorasan, Sistan & Baluchistan](Zamani *et al.*, 2014, 2018, 2021); Turkmenistan and Aral Sea (Marusik & Kovblyuk, 2009).

Minosiella mediocris Dalmas, 1921 Egypt [Cairo, El-Fayum, Suez (Dalmas, 1921), Siwa Oasis (Denis, 1947)]; Tunisia [Nefzana, Tozzer], Algeria [Biskra](Dalmas, 1921); Palestine/Israel [Makhtesh Ramon](Levy, 1995).

Minosiella pallida (L. Koch, 1875) Abyssinian province of Hamaszen (L. Koch, 1875); Yemen [Aden](Simon, 1882); Eritrea [Hamasien province, Massawa], Djibouti, Yemen [Aden], Oman [Muscat], Pakistan [Karachi](Dalmas, 1921).

Minosiella perimensis Dalmas, 1921 Yemen [Prim](Dalmas, 1921).

Minosiella pharia Dalmas, 1921 Egypt [Cairo](Dalmas, 1921); Libya (?), Palestine/Israel [Be'er Mash'abbim](Levy, 1995).

Minosiella spinigera (Simon, 1882) Yemen [Aden](Simon, 1882; Dalmas, 1921).

Fig. 17. Distribution map of *Minosiella* species in Egypt.

● = *Minosiella mediocris* Dalmas, 1921 Cairo, El-Fayum, Siwa Oasis, Suez
● = *Minosiella pallida* (L. Koch, 1875) Serabium (Ismailia)
● = *Minosiella pharia* Dalmas, 1921 Cairo

Note. According to Marusik & Kovblyuk (2009), there is a possibility that *M. pallida* and *M. intermedia* are synonyms. This needs comparing of more specimens of the two species.

Comparison of measurements of known *Minosiella* species [in mm] (from literature):

Minosiella apolakia Chatzaki, 2019 ♀
Chatzaki, 2019: ♀. TL 5.15; CL 2.30; CW 1.65; AL 2.54. (Legs 4, 1, 2, 3).

Minosiella intermedia Denis, 1958 ♂♀
Denis, 1958: ♀. TL 4.4-6.7, CL 2-2.5.
Marusik & Kovblyuk, 2009: (♂/♀): TL 4.4/3.8; CL 1.9/2.1, CW 1.6/1.7. AL 2.3/2.3.

Minosiella mediocris Dalmas, 1921 * ♂♀
Dalmas, 1921: ♂ 3-4, ♀ 4-6. Legs IV-I-III-II (8-6.6-6-5.9 for a ♀ of 6 : CL 2.7, AL 3.2).
Levy, 1995: (2♂♂): TL 3.1-3.4; CL 1.5-1.8, CW 1.3-1.4, legs length: (I) 3.60-4.35, (II) 3.50-4.15, (III) 3.7-4.5, (IV) 5.2-6.0. (2♀♀): TL 4.1-4.3; CL 1.7-2.2, CW 1.4-1.7, legs length: (I) 3.65-4.45, (II) 3.35-4.05, (III) 3.6-4.3, (IV) 5.0-6.2.

Minosiella pallida (L. Koch, 1875) ♂♀
L. Koch, 1875: ♀. TL 5.25. CL 2.25, AL 3.0, Leg I & II 4.5, III 4.0, IV 5.5. (Legs 4, 1, 2, 3).
Simon, 1882: ♀. TL 6.7, CL 2.4; AL 4.3. (Legs 4, 1, 2, 3). ♂. CL 2.2.
Dalmas, 1921: TL ♂ 3.6, ♀ 4-6.

Minosiella perimensis Dalmas, 1921 ♀
Dalmas, 1921: ♀ TL 3.

Minosiella pharia Dalmas, 1921 ♂♀
Dalmas, 1921: ♀ TL 4.25.
Levy, 1995: (3♂♂): TL 3.5-4.6; CL 1.7-2.1, CW 1.5-1.9, legs length: (I) 4.2-4.8, (II) 4.0-4.8, (III) 4.6-5.4, (IV) 5.3-6.9. (3♀♀): TL 4.0-6.0; CL 1.6-2.3, CW 1.3-2.0, legs length: (I) 3.2-4.5, (II) 3.0-4.4, (III) 3.4-5.0, (IV) 4.7-6.6.

Minosiella spinigera (Simon, 1882) ♂♀
Simon, 1882: ♀. CL 2.6; AL 4.5. Legs 4, 1, 2, 3. ♂. CL 2.4.
Dalmas, 1921: ♂ TL 4-5. ♀ TL 7.5. Legs IV-I-III-II (7.7 - 6.6 - 5.7 - 5.5 for a ♀ of 7.5).

Total length:

Minosiella apolakia ♀ 5.15.
Minosiella intermedia ♀ 4.4-6.7, 3.8. ♂ 4.4.
Minosiella mediocris ♀ 4-6, 4.1-4.3. ♂ 3-4, 3.1-3.4.
Minosiella pallida ♀ 5.25, 6.7, 4-6. ♂ 3.6.
Minosiella perimensis ♀ 3.
Minosiella pharia ♀ 4.25, 4.0-6.0. ♂ 3.5-4.6.
Minosiella spinigera ♀ 7.1, 7.5. ♂ 4-5.

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First record of *Pterotricha kovblyuki* Zamani & Marusik, 2018 (Araneae: Gnaphosidae) from Iraq

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Abstract

The species *Pterotricha kovblyuki* Zamani & Marusik, 2018 is recorded in Iraq for the first time. The specimens were collected from desert habitat located southwest of Thi Qar Province, south of Iraq. The species was described from Iran and United Arab Emirates (UAE). Illustrations of the species and a map of the specimens collecting location are provided.

Keywords: Araneae, First record, *Pterotricha kovblyuki*, Iraq, Ziggurat of Ur.

Introduction

There are few studies on spider fauna in Iraq, but in recent years spiders have received the attention of some Iraqi researchers (e.g. Al-Abbad *et al*., 2019; Najim & Al-Hadlag, 2020; Al-Khazali, 2021).

Gnaphosidae is a family of global distribution that currently includes 2583 species extant in 164 genera (World Spider Catalog, 2021), characterized by its long and cylindrical anterior spinnerets, and enlarged piriform glands spigots (Jocqué & Dippenaar-Schoeman 2006).

Genus *Pterotricha* Kulczyński, 1903 currently includes 44 valid species that are known in the Old World, primarily from the Middle East, North Africa, and Central Asia, in the deserts and semi-arid habitats (Levy, 1995; World Spider Catalog, 2021). *Pterotricha* (Gnaphosinae) spiders are medium-sized 5-13 mm in body length, anterior

pair of spinnerets in form of rigid, brownish, cylindrical tubes markedly longer than other spinnerets (Levy, 1995).

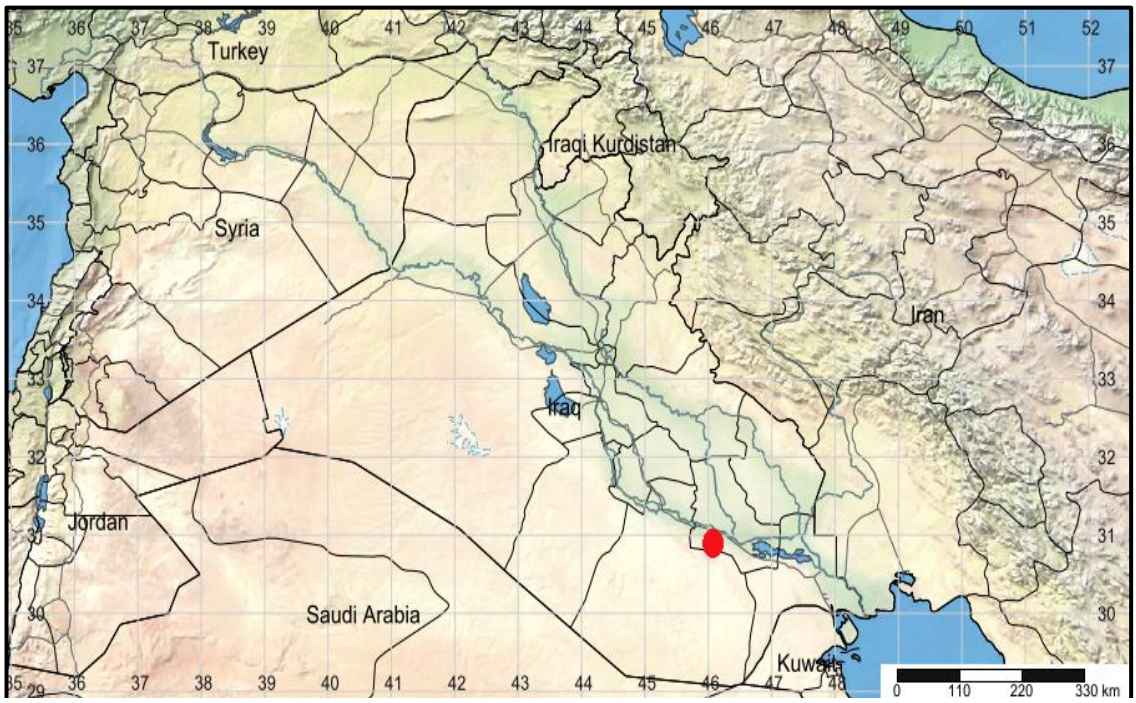

Fig. 1. Map of collecting location (red circle): Thi Qar Province, southwest of Al-Nasiriyah city, Ziggurat of Ur.

Material and Methods

The samples were taken from Thi Qar Province, southern Iraq (Fig. 1), at a site near the archaeological Ziggurat of Ur, which is a desert area (Fig. 2). Specimens were preserved in 70% ethanol, photographed with a Nikon Z50 on a Krüss stereomicroscope, then digital images were prepared using image stacking software (Zerene stacker). The measurements were given for the segments of the legs (femur, patella, tibia, metatarsus, tarsus). All measurements are given in millimetres. The map was created using an online web page **(**http://www.simplemappr.net/).

Taxonomy

Family **Gnaphosidae** Banks, 1892
Genus ***Pterotricha*** Kulczyński, 1903

Pterotricha kovblyuki Zamani & Marusik, 2018 (Figs. 3-4)
Pterotricha kovblyuki Zamani & Marusik, in Zamani *et al*. 2018: 21, f. 2a-g (♂).

Material Examined. 2♂♂, Ziggurat of Ur, Thi Qar Province, south of Iraq, 30°58'10.0"N, 46°06'53.0"E, May 2021.

Diagnosis. The conductor has a thinner tip and the tegular apophysis is longer than the width and has a spine like tip as in the tibial apophysis [Figs. 2f, 3f in Zamani (2018) and Figs. 2c, e-g in Zamani *et al*. (2018)].

Fig. 2. The habitat of *Pterotricha kovblyuki*, Ziggurat of Ur.

Description of Male. Habitus as in Fig. (3). Total length 7.5. Carapace 3 long, 2.5 wide. Opisthosoma 4.0 long. Carapace, labium, sternum, and maxillae are light brown. Carapace dorsal surface striped with the shape of "Y". Eyes are arranged in two rows, median eyes are oval in shape and lateral eyes are very close to median eyes. Abdomen light grey with distinct pale mark and two pairs of dots on sides. Legs have clear spines, with the following measurements: I 13.55 (3.5, 1.25, 2.9, 3.5, 2.4), II 12.8 (3.0, 1.0, 2.8, 3.5, 2.5), III 13.9 (3.25, 1.25, 2.8, 4.0, 2.6), IV 16.9 (4.0, 1.5, 3.5, 5.0, 2.9). Tarsi of legs with pseudosegmentations.

Fig. 3. *Pterotricha kovblyuki* Zamani & Marusik, 2018 ♂. Habitus, dorsal view.

Fig. 4. *Pterotricha kovblyuki* Zamani & Marusik, 2018 ♂. Palp, ventral view. (*Co* = conductor, *Em* = embolus, *Te a* = tegular apophysis, *Ti a* = tibial apophysis).

Palp as in Fig. (4), patella and tibia are equal in length. Tibial apophysis (*Ti a*) with a spine like tip. Tegular apophysis (*Te a*) longer than wide with tip rounded. The embolus (*Em*) has a very thin tip, slightly bent towards the tip of the conductor (*Co*).
Female. Unknown.

Distribution. *Pterotricha kovblyuki* Zamani & Marusik, 2018 was previously known only from Iran and two regions in the United Arab Emirates. It is recorded in the current study from southern Iraq.

Discussion

The fauna of spiders in Iraq is still not sufficiently studied. Levy (1995) confirmed that the species of genus *Pterotricha* are distributed in the Middle East and North Africa. In Iraq, only two species of this genus were previously recorded: *P. arzhantsevi* Fomichev, Marusik & Koponen, 2018 by Fomichev *et al*. (2018) and *P. esyunini* Zamani, 2018 by Al-Yacoub *et al*. (2021).

In the current study, a third record of this genus is reported and the first record of *P. kovblyuki* in Iraq. It was previously diagnosed only in Iran (Zamani *et al*., 2018) and United Arab Emirates (UAE) by Zamani (2018). Females are unknown for this species.

It is probable that many species of this genus will be diagnosed in Iraq which contains many desert and semi-arid habitats.

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A study of the diet and reproductive behaviour of *Galeodes araneoides* (Pallas, 1772) (Arachnida: Solifugae) in the field and laboratory conditions

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Abstract

The data of field and laboratory studies of feeding, mating behaviour (of 19 pairs observed in the field), reproduction of the solifuge (Camel-spider) *Galeodes araneoides*, as well as moulting and age-related feeding characteristics of nymphs at different stages of development are presented. Arthropods of 4 classes, 12 orders, 19 families were found in the diet of solifuges under natural conditions. Positive selectivity was noted for some groups of food objects: Isopoda, Araneae, Opiliones, Orthoptera, Hymenoptera. In the laboratory, when feeding solifuges by the most abundant representatives of the fauna of arthropods caught in nature, predators have shown preference for prey of representatives of 3 classes, 8 orders, and 23 families (mainly insects and spiders). The intensity of feeding and the width of its spectrum in nymphs under laboratory conditions increases with their age, reaching their maximum by the onset of the adult stage.

Keywords: Camel-spider, feeding spectrum, mating, oviposition, nymphs, feeding intensity.

Introduction

The distribution area of the solifuge (Camel-spider) *Galeodes araneoides* (Pallas, 1772) (Solifugae, Galeodidae) extends from North Africa to Central Asia (Harvey, 2003). In Azerbaijan, this species is found in low-lying, flat, foothill and low-mountain semi-arid landscapes in the regions of the Greater and Lesser Caucasus, the Lankaran natural

region (Talysh mountains), the Kura-Araz lowland, in the Gobustan low-mountain massif, and on the Absheron peninsula (Gadzhiev, 1996).

Being active predators with extremely intense feeding behaviour and extremely high search activity of prey, *Galeodes araneoides* play an important role in the trophic relationships of ecosystems of semi-desert biocenoses. Being extremely voracious predators, these arachnids, with their high numbers, are able to destroy more harmful insects than all other arachnids living in the same regions combined (Aliev, 1984b).

Their no less important role is assumed in agrocenoses (vine plantations, cotton and grain fields, vegetable gardens, melons and orchards), which requires the collection of additional representative data on the bioecology of this species.

Information on nutrition, reproduction and reproductive behaviour of this species in the Transcaucasus presented in the literature (Aliev & Gadzhiev, 1983; Aliev, 1984a,b) is insufficient for an objective assessment of their role in biocenoses, and therefore any new data on these issues are relevant and may be of scientific and practical interest.

The purpose of this work was to determine the circle of prey of *Galeodes araneoides*, to study their reproductive behaviour, moult, and feeding intensity of nymphs at different stages of postembryonic ontogenesis.

Material and Methods

Data on the feeding and reproduction of the solifuge *Galeodes araneoides* were collected during field studies in the summer months of 2018 in the south-eastern part of the Shirvan plain (eastern Azerbaijan) and during their keeping under laboratory conditions. The composition and number of eaten objects was determined by their remains found in the shelters of the solifuges during the daytime, as well as during night time visual observations when preys were found on the chelicerae of predators. More than 130 solifuges shelters were examined. Chitin residues of 529 specimens arthropods suitable for identification were analyzed. Eating 584 specimens arthropods was observed. The total number of observed feeding solifuges was 46 individuals. The taxonomic composition and frequency of occurrence of invertebrates in biotopes were determined using standard entomological methods of counting (manual collecting, installation of soil traps) (Gilyarov, 1975). Food items were determined up to orders and families. The importance of certain representatives of the invertebrate fauna in the diet of solifuges was established by calculating the electivity index (Ivlev, 1955): $I_E = (r - p)/(r + p)$, where r - is the percentage of the object in the food composition, p - is the percentage of the object in the biotope. Under laboratory conditions, adult solifuges were offered living objects of different taxa, delivered from natural habitats and cultivated in insectarium. A total of 326 arthropod species differing in biomass, linear size, mobility and modes of movement were proposed. A complete timekeeping of the process of eating food was carried out in 19 solifuges. The reaction of the solifuges to each of the proposed objects was noted. Objects ignored or avoided by predators were immediately removed from the cages.

Observations of male courtship of females and mating were carried out in the field. Observations of oviposition and development of larvae and nymphs were carried out in laboratory conditions. The nymphs were fed by arthropods of 14 species bred in the institute's insectarium. To determine the intensity of feeding of nymphs, the objects of the study were weighed before and after food activity on an electronic balance with an accuracy of 0.01 g. The primary data were processed by methods of variation statistics in Microsoft Excel 2010.

Results and Discussion

Feeding spectrum. Representatives of 4 classes, 12 orders, 19 families, with a predominance of Araneae, Hemiptera, Orthoptera, Hymenoptera, and Coleoptera, were noted in the diet of solifuges under natural conditions (Table 1). Solifuge food consisted of three well-defined dominant components: Hymenoptera (up to 49.6%), Hemiptera (up to 28.3%), and Orthoptera (up to 18.6%). The rest of their food items were represented by several taxonomic groups, the ratio of which varied depending on the type of biotope. So, in the loamy-gray soil plain part, this species also consumed Araneae, Coleoptera, and Diptera. In stony areas, Coleoptera and Diptera predominated in food. In rocky areas, Lepidoptera and Isopoda were also added to the components of the "plain" diet.

Table 1. The feeding spectrum of *Galeodes araneoides* in south-eastern Shirvan, established from the found remains of food objects and visually with Electivity Index (EI) values for prey taxa.

Food objects	In the biotope		In food				EI
			visually		by chitinous fragments		
	abs.	%	abs.	%	abs.	%	
Isopoda	95	9.1	16	2.7	69	13.0	0.17
Chilopoda	125	11.9	–	–	14	2.6	-0.81
Araneae	78	7.4	148	25.3	35	6.6	0.35
Opiliones	58	5.5	83	14.2	13	2.4	0.19
Coleoptera	186	17.8	103	17.6	94	17.7	-0.03
Lepidoptera	64	6.1	46	7.8	21	3.9	-0.04
Orthoptera	101	9.6	81	13.8	61	11.5	0.11
Hemiptera	77	7.3	23	3.9	28	5.2	-0.25
Diptera	81	7.7	17	2.9	63	11.9	-0.06
Dermaptera	46	4.4	11	1.8	23	4.3	-0.22
Hymenoptera	97	9.3	56	9.5	96	18.1	0.15
Blattodea	34	3.2	–	–	12	2.2	-0.52

The preference of victims of certain taxa was noted. According to the found chitinous fragments, Isopoda (13%), Coleoptera (17.7%), Orthoptera (11.5%), Diptera (11.9%), and Hymenoptera (18.1%) prevailed among the victims of solifuges. According to visual observations, Araneae (25.3%), Opiliones (14.2%), Coleoptera (17.6%), Orthoptera (13.8%), and Hymenoptera (9.5%) are more often observed in the diet of solifuges. According to the electivity index, positive selectivity was determined for such groups of victims as Isopoda (0.17), Araneae (0.35), Opiliones (0.19), Orthoptera (0.11), and Hymenoptera (0.15) (Table 1). For example, the proportion of the remains of Opiliones, Coleoptera, Lepidoptera (larve), Hymenoptera, and Isopoda in relation to other groups in the shelters of solifuges exceeded the proportion of these invertebrates in relation to other groups in the biotope. Males feed much less frequently than females and immature individuals of both sexes. *G. araneoides* more often caught medium-sized prey, the body length of which was 30-50% of the body length of the predators themselves. They actively pursue their prey and capture it with a short lunge or attack from an ambush in cover. Low-flying prey (beetles, butterflies) is deftly seized, sharply jumping up to a height of 80 cm.

Selectivity to food items was also noted when feeding adult male and female solifuges in the laboratory. Under laboratory conditions, solifuges were equally offered

both arthropods caught in nature and artificially cultivated food insects. All food items offered to solifuges were grouped according to biomass, body size, degree of mobility and mode of movement. The time of interaction with the victim mainly depended on the size and mass of the victim, and not on its mode of movement and degree of mobility (Table 2).

Table 2. Time spent on eating prey of *Galeodes araneoides* (n = 19) in laboratory conditions.

Body length of prey (mm)	Mass (g)	Movement methods of prey	Interaction time with a prey (min.)
15-20	0.14-0.19	crawling	12.27±1.03
		running	14.1±4.16
		jumping	12.12±3.79
21-25	0.21-0.25	crawling	17.74±1.34
		running	18.39±4.98
		jumping	23.18±1.78
26-30	0.27-0.35	crawling	19.41±1.47
		running	20.82±1.59
		jumping	28.94±2.25
35-45	0.42-0.75	crawling	21.3±1.69
		running	28.6±1.22
		jumping	31.4±3.35

Of the food items offered to the solifuges (326 species), 58 species (17.8%) were ignored or avoided. Such objects included desert woodlice (*Hemilepistus*), millipedes (Geophilomorpha), furry caterpillars of Lepidoptera (Lymantriinae, Arctiidae, Sphingidae, Zygaenidae), some coleopterans (Scarabaeus, Blapsidae, Capnodis) and bedbugs (Pentatomidae), from Orthoptera: large specimens of the mole cricket (Gryllotalpidae), and from Hymenoptera: ants (Formicidae). A selective attitude towards food items was more pronounced in male solifuges.

Reproductive behaviour. According to the literature, mating of solifuges under the conditions of Azerbaijan begins in May at an average daily temperature of 20°C and continues until the end of August (Aliev, 1984a). Our observations were carried out in the summer months and mating solifuges were observed at average daily temperatures of 24-26°C.

In the daytime and at night, we searched for pairs ready for mating. Over the entire period of research, 54 adult individuals were noted. Of these, 38 were potential pairs ready for breeding. The individuals that make up such mating pairs were located close to each other, but in different shelters. According to our observations, male solifuge, in search of a fertile female, cover distances from 80-100 to 200 m and more until they find a mate ready for mating. The maximum distance covered by males at night in search of a female was about 350 m.

Having found a fertile female, the male actively tries to care for her. If the female shows aggression, the male temporarily stops the courtship attempt and moves away for some time at a safe distance from her. We found such pairs preparing for mating at the end of June, at the beginning and in the middle of July. Male and female were usually located in different shelters, but located at a short distance from each other (2-5 m). After some time (from several hours to a day), the male repeats his attempt at courtship. It always approaches it from the ventral side. If the female turns sharply towards him with chelicerae, this means that she is still not ready to accept his courtship. The male can repeat courtship attempts many times (up to 5-7 times), but more often he manages to achieve the location of the female already from the 3rd attempt.

During courtship, male first uses pedipalps, then chelicerae grab onto the propeltidium or abdomen of the female to force her into a state of trance or numbness. After the female enters a state of numbness, the male uses his chelicerae to position the female and to indirectly transfer the spermatophore into the female genital opening. At the same time, the male bends his abdomen over her millet and transfers the spermatophore with his chelicerae to her genital opening (Punzo, 1998). Sometimes the male, releasing the spermatophore from the genital opening, continues to chew as if massaging the abdomen of the female with chelicerae, apparently so that she does not come out of the trance state ahead of time. Then he transfers the spermatophore with chelicerae to the female genital opening. The female, after a few minutes after that, begins to come out of the state of numbness and the male hurries to retire away from her, so as not to be eaten by his partner. The whole mating procedure usually lasts from 7 to 15 minutes, in rare cases, if the female behaves inappropriately, the process is delayed up to 20 minutes. Postcoital cannibalism in female solifuge has been noted in the literature (Cloudsley-Thompson, 1977). We observed mating behaviour in the field in 19 pairs of solifuges, and only in one case the male was eaten by the female after the mating procedure. The observed pairings lasted on average 7 min and can be conditionally divided into several stages. At the first stage, the male approaches the female with raised pedipalps. The female either responds with aggression - raises the pedipalps and tries to attack the male, or falls into a daze after touching his pedipalps. If the female reacted aggressively, the male would suddenly attack her by attaching to her body using suckers on the pedipalps (Cushing *et al.*, 2005), and biting her propeltidium until the female falls into a trance state. Then he made chelicerae biting the lateral and ventral parts of her abdomen in the genital opening. Continuing to perform chewing movements, the male raised himself on outstretched limbs and released the spermatophore. Then the male grabbed the spermatophore with chelicerae and placed it in the female's genital opening. The literature indicates that after successful copulation, males seek and try to copulate with other females (Junqua, 1966; Muma, 1966a; Wharton, 1987; Punzo, 1997). It is believed that each male is capable of mating several times, unless it is eaten by one of the first females he meets. According to Aliev (1984b) one male can fertilize from one to four females. However, in our case, we did not observe this. Of course, it can be assumed that the breeding males we observed had relationships with other females even before the beginning of our observations.

Some of the fertilized females (n = 9) and the males that mated with them (n = 8) were captured and taken to the laboratory, where they were placed in separate plastic containers with 10 cm of soil and shelters. In the laboratory, females and males were offered daily food insects raised in the insectarium. After mating, the males were the first to refuse food and after 7-12 days all died. Females, on the other hand, took food quite actively and laid eggs approximately 20-25 days after mating.

Before oviposition, the females dug horizontal widened burrows in the ground under a cover 8-12 cm long. There were 57-71 eggs in clutches. The eggs were whitish, spherical, 2.6-2.8 mm in diameter. After about 5–8 days (at a temperature of 26°C) from laying eggs, underdeveloped and practically immobile larvae (postembryos) hatched (Muma, 1966b). They were in a larval shell, not capable to move or to feed, they lacked articulation of the trunk and limbs. The larvae moulted one after another to nymphs of the first instar after about 11-17 days.

The first instar nymphs remained in burrows for the first 5-7 days, then gradually began to leave the mother's nest and scatter over the entire area of the container in search for food. In 7 females, guard behaviour was observed. They guarded the nest until all the larvae left it. Only two females, having laid eggs, abandoned the clutch, which is not typical for galeodids (Cloudsley-Thompson, 1967). After 30-35 days, nymphs of the first age stopped feeding and, hiding in shelters for 7-9 days, fell into a torpor in order to moult again turning into nymphs of the second instar. The nymphs of the second instar feed for a short time (4-6 days), and until May of the next year they leave for the winter, hiding in ready-made shelters, since they apparently cannot dig holes themselves. The nymphs of the second instar emerge from the winter pause by mid-May at an average daily temperature of 18°C, and, until the beginning of August, they actively feed, then fall into a torpor for 7-8 days, and then moult into nymphs of the third instar. Third instar nymphs, already capable of digging small burrows, actively feed during all the rest of the season, hibernate and moult into fourth instar nymphs the next year in June-July. In this order, the development of young solifuges proceeds, which during the entire life cycle go through the larval and 5 nymphal stages, and, only in the fourth year of life, they reach the adult state.

Moulting. Moulting is an extremely crucial moment in the postembryonic development of solifuges. It was found that all nymphal stages 7-8 days before moulting lose activity and do not feed. During this period, they are looking for a suitable ready-made shelter (nymphs of 1-2 instars), or they dig a hole (nymphs of 3-5 instars), where they fall into a daze in a characteristic pose with limbs lifted up. In this state, the nymphs of the first and second instars stay for 6-7 days, the third instar - 7-8 days, the fourth instar - 9-10 days, the fifth - 12-15 days. At first, after adopting the characteristic moulting posture, the cuticle is stretched, the boundaries between the body segments are lost. The shedding of the cuticle occurs as follows: sharp movements begin, such as successive wave-like contractions, as a result of which the cuticle breaks in the back area. In this position, rhythmic movements continue for another 9-12 minutes. During this time, the back of the body is freed from the cuticle by about one quarter. After that, the solifuge turns over on one side, its body takes the shape of a semicircle and, with rhythmic movements, it continues to free itself from the remaining cuticle. Then the solifuge turns over on his back with a sharp movement and with continuous wave-like movements of the body is completely freed from the cuticle. On average, it takes about 120 minutes for a fifth-year solifuge to shed the cuticle.

Intensity of nymph feeding. Under laboratory conditions, the trophic activity of solifuges was studied at different stages of postembryonic development (Table 3). Nymphs of different ages kept separately were offered food insects of different taxonomic and size groups: Drosophila (*Drosophila melanogaster*), larvae and imago of flour beetle (*Tenebrio molitor*), crickets (*Gryllus bimaculatus*, *Acheta domesticus*), locusts (*Locusta migratoria*, *Chortoicetes terminifera*), blowfly (*Calliphora erythrocephala*), soldier fly (*Hermetia illucens*), grain moth (*Sitotroga cerealella*), Turkestan cockroach (*Shelfordella lateralis*), oriental cockroach (*Blatta orientalis*),

greater wax moth (*Galleria mellonella*), lesser wax moth (*Achroia grisella*), wood louse (*Porcellionides pruinosus*).

Table 3. Intensity of feeding of *Galeodes araneoides* at different nymphal stages in laboratory conditions.

Nymphal stage	n	Feed type object	Average weight (g)	Quantity of eaten objects	Weight of eaten objects (g)	Total weight (g)
I	17	*Drosophila melanogaster*	0.04	48	1.92	7.17
		Tenebrio molitor	0.11	24	2.64	
		Sitotroga cerealella	0.09	29	2.61	
II	17	*Hermetia illucens*	0.07	18	1.26	8.31
		Tenebrio molitor	0.11	29	3.19	
		Achroia grisella	0.12	18	2.16	
		Calliphora erythrocephala	0.10	17	1.70	
III	17	*Galleria mellonella*	0.23	19	4.37	14.43
		Calliphora erythrocephala	0.10	17	1.70	
		Shelfordella lateralis	0.12	25	3.0	
		Achroia grisella	0.12	19	2.28	
		Gryllus bimaculatus	0.14	22	3.08	
IV	17	*Shelfordella lateralis*	0.12	28	3.36	32.48
		Porcellionides pruinosus	0.09	21	1.89	
		Galleria mellonella	0.23	34	7.82	
		Acheta domesticus	0.17	27	4.59	
		Chortoicetes terminifera	0.22	19	4.18	
		Locusta migratora	0.42	17	7.14	
		Gryllus bimaculatus	0.14	25	3.50	
V	17	*Blatta orientalis*	0.31	19	5.89	45.78
		Locusta migratora	0.42	20	8.40	
		Galleria mellonella	0.23	25	5.75	
		Chortoicetes terminifera	0.22	19	4.18	
		Shelfordella lateralis	0.12	26	3.12	
		Tenebrio molitor	0.11	39	4.29	
		Gryllus bimaculatus	0.14	24	3.36	
		Acheta domestica	0.17	29	4.93	
		Calliphora erythrocephala	0.10	37	3.70	
		Porcellionides pruinosus	0.09	24	2.16	

Food items were offered to the solifuges every day. Refusal to eat was observed 8-10 days before moult and 4-5 days after moult. In addition, refusal to eat food was noted during the calendar period corresponding to the wintering period, which may indicate the adherence of solifuges to a clear seasonal rhythm, regardless of the external temperature conditions of their maintenance.

Conclusion

The taxonomic composition of prey in the dietary spectrum of solifuges is mainly formed at the expense of invertebrates, which are widely represented in the biotope and

have a rhythm of seasonal activity similar to them. Positive selectivity was noted for some groups of preys: Araneae, Opiliones, Orthoptera, Hymenoptera. The original data of field and laboratory studies and observations on reproductive behaviour, reproduction biology and moulting of *Galeodes araneoides* of different age groups are presented. The intensity of feeding and the width of its spectrum of nymphs increases with the age of solifuges, reaching a maximum by the onset of the adult stage.

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Updated checklist of spider diversity (Arachnida: Araneae) in Haryana, Himachal Pradesh, Punjab, Chandigarh and Delhi (India)

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Abstract

An updated checklist of faunal biodiversity of the spiders in three north and northwest Indian states (Haryana, Himachal Pradesh, Punjab) and two union territories (Chandigarh, Delhi) is presented herewith. A total of 242 species of spiders described under 127 genera belonging to 31 families were recorded in above mentioned states/union territories of India. The biodiversity of spider is maximum in Punjab (109 species, 64 genera, 19 families) followed by Himachal Pradesh (90 species, 58 genera, 22 families), Haryana (59 species, 39 genera, 16 families), Delhi (53 species, 43 genera, 18 families), and Chandigarh (7 species, 7 genera, 5 families). However, most of the areas in all three states and two union territories are still virgin where no survey of the spider fauna and hence, they need intensive and extensive survey plans in those areas by wholehearted workers.

Keywords: Spiders, Araneae, checklist, faunal distribution, Chandigarh, Delhi, Haryana, Himachal Pradesh, Punjab, India.

Introduction

Spiders (Arachnida: Araneae) are most omnipresent and numerous like insects in both agricultural and natural ecosystems and constitute an array of arthropod predators and also act as sensitive bioindicators of the environmental changes (Jansen, 1997). Almost all spiders predate mostly on insects and are known to kill as much as 50 times the number of prey they actually consume (Kajak, 1978). The vast majorities of spiders

are harmless and serve a critical purpose: the regulation of insect populations that could otherwise ruin the crops. Like honey bees, if the spiders disappear from the surface of the earth, man would have no more than few years left to live due to food shortage beacuase of insect pest infestation. Also, the most remarkable feature of the life of spiders is the use of its silk, the spider has mechanism to turn its food into silk and using it to catch more food. In spite of these, the spiders are least admired because of commonness of spider phobia in public (Zvaríková, 2021), particularly in women (Polák *et al.*, 2020). Globally, the order Araneae ranks seventh (49,799 species in 4,234 genera belonging to 129 families (World Spider Catalog, 2021)) after the five largest insect orders (Coleoptera, Lepidoptera, Hymenoptera, Diptera, and Hemiptera) and one arachnid order (Acari) in terms of species diversity (Sharma *et al.*, 2020a). In India, 2344 species described under 596 genera comprising 65 families were enlisted by Singh & Singh (2021a), however, Caleb & Sankaran (2021) listed only 1887 species belonging to 481 genera in 60 families.

Species inventory is one of the prime necessities for setting up biodiversity conservation action plan for any given region. The conservation status of 99.5% of the spider species has not yet been appraised by the IUCN globally (Seppälä *et al.*, 2018). Despite recent research works on the diversity and distribution of spiders in India, their number is insufficient as compared to the other parts of the world because in general, studies on spiders are highly neglected in most of the areas of the country. The perusal of literature demonstrates that the available information on the spiders of the north and northwest states (Haryana, Himachal Pradesh, and Punjab) and union territories (Chandigarh and Delhi) is scattered and more than 60% of the areas have not yet been surveyed for faunal distribution of spiders. Recently, the checklist of spider fauna of northeast Indian states (Singh & Singh, 2021a), Bihar and Jharkhand (Singh & Singh, 2021b) and Uttar Pradesh and Uttarakhand (Singh & Singh, 2022) have been compiled. In this continuation, the present article enlists the spider fauna of three north and northwest Indian states, Haryana, Himachal Pradesh, and Punjab and two union territories, Chandigarh and Delhi.

Material and Methods

The present checklist is based on the published literature on the spiders from India in recent past books, book chapters, journals, proceedings, records of Zoological Survey of India, Kolkata, few authentic theses, websites, and World Spider Catalog (2021) up to November 15, 2021. In most of the literature published earlier, there were several errors in the scientific names of the spiders even in the recent publications because the researches on spider taxonomy like other taxa are continued with the description of new taxa, their modified status, and the publication of other nomenclatural decisions and clarifications. In the present checklist, attempts have been made to correct the errors in the scientific names of the spiders following World Spider Catalog (2021). If a spider species is identified only up to a generic level, it was considered as species if no other species of that genus is reported within that state. In few cases, the locations of spider species are corrected, particularly of those spiders that were described/recorded during the British period and even after the independence of India (1947) till the reorganisation of these states in 1966. For synonymy and endemism, following references may be looked at for 31 families of spiders recorded in these states and union territories, e.g. Amaurobiidae (Singh *et al.*, 2021), Araneidae (Singh & Singh, 2021c), Cheiracanthiidae (Singh *et al.*, 2020a), Clubionidae (Singh BB *et al.*, 2020), Corinnidae (Singh *et al.*, 2021); Ctenidae (Singh BB *et al.*, 2020), Eresidae (Sharma *et al.*, 2021), Gnaphosidae

(Singh & Singh, 2021d), Hersiliidae (Singh *et al.*, 2020b), Linyphiidae (Sharma *et al.*, 2020a), Liocranidae (Sharma *et al.*, 2020b), Lycosidae (Singh, 2021a), Oecobiidae (Sharma *et al.*, 2020b), Oonopidae (Tiwari *et al.*, 2021a), Oxyopidae (Singh, 2021b), Philodromidae (Singh & Singh, 2021e), Pholcidae (Tiwari *et al.*, 2021b), Pimoidae (Tiwari *et al.*, 2021c), Pisauridae (Tiwari & Singh, 2021), Psechridae (Tiwari *et al.*, 2021c), Salticidae (Singh *et al.*, 2020c, d, e, f), Scytodidae (Singh BB *et al.*, 2021), Selenopidae (Tiwari *et al.*, 2021c), Sparassidae (Singh, 2021c), Tetragnathidae (Singh, 2021d), Theraphosidae (Singh & Singh, 2020), Theridiidae (Singh, 2021e), Thomisidae (Singh & Singh, 2021f), Titanoecidae (Singh & Singh, 2021g), Trochanteriidae (Singh & Singh, 2021g) and Uloboridae (Singh & Singh, 2021g).

Results and Discussion

A total of 242 species of spiders described under 127 genera belonging to 31 families were recorded in all three states of north (Himachal Pradesh) and northwest India (Haryana, Punjab) and two union territories (Chandigarh, Delhi) (Fig. 1). The biodiversity of spider is maximum in Punjab (109 species, 64 genera, 19 families) followed by Himachal Pradesh (90 species, 58 genera, 22 families), Haryana (59 species, 39 genera, 16 families), Delhi (53 species, 43 genera, 18 families), and Chandigarh (7 species, 7 genera, 5 families). However, most of the areas in all these regions are still virgin regarding the faunal survey programmes and need intensive and extensive survey in those areas by wholehearted workers.

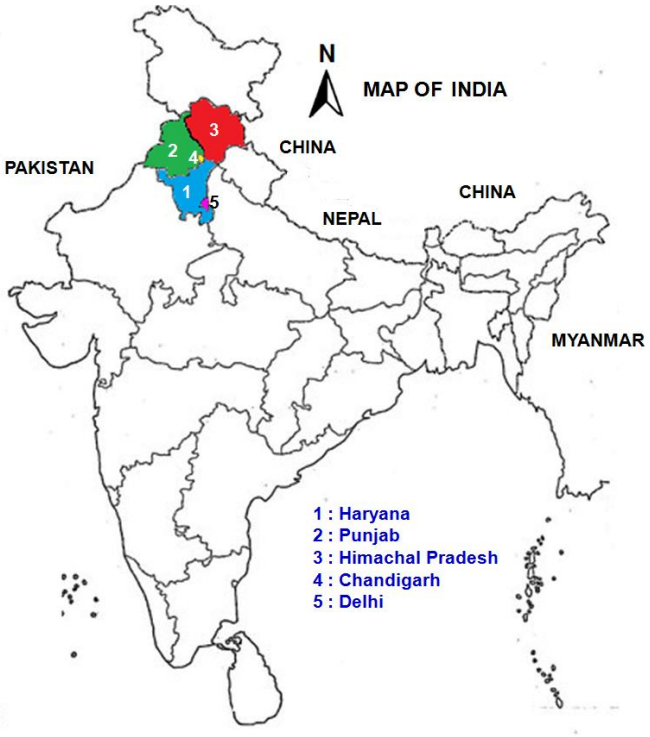

Fig. 1. Map of India showing Haryana, Punjab and Himachal Pradesh (Indian states), and Chandigarh and Delhi (Union territories).

Following is the list of spiders recorded/described from three north and northwest states and two union territories of India.

A. Haryana

Haryana (latitude: 27°39' to 30°35'N, longitude: 74°28' to 77°36'E) is one of the landlocked north Indian states having the total geographical area of 44,212 km^2. It was carved out of the state of Punjab in 1966. Haryana is divided into 22 districts (Fig. 2). Haryana is bordered by Himachal Pradesh to the north-east, Uttar Pradesh to the east along the river Yamuna, Rajasthan to the west and south, and Punjab to north along the river Ghaggar-Hakra and surrounds the Delhi (capital of India) on three sides (north, west, and south). The state has only 4% area under mostly thorny, dry, deciduous forest with thorny shrubs. Haryana has four main geographical regions, (a) the Yamuna-Ghaggar plain forming the largest part of the state consisting three doabs (land lying between two confluent rivers), Delhi doab (between Sutlej in north in Punjab and Ghaggar river in northern Haryana), Ghaggar-Hakra doab (between Ghaggar river and Hakra or Drishadvati river) and Hakra-Yamuna doab (between Hakra river and Yamuna), (b) the lower Shivalik Hills to the northeast in foothills of Himalaya, (c) the Bagar tract, a semi-desert dry sandy plain to the south-west, and (d) the Aravali Range in northernmost low rise. There are several lakes and seasonal waterfalls and one hot spring in Haryana. Temperature reaches upto 45ºC in summer, however, winter is mild. The average rainfall is 355 mm. During monsoon, the hills are covered with grass. The state has two national parks, two wildlife conservation areas, four animal and bird breeding centres, eight wildlife sanctuaries, and three zoos. In spite of rich flora, arthropod fauna is inadequately documented.

Fig. 2. Map of Haryana showing the number of species of spiders described/recorded in different districts.

Regarding the spider diversity in Haryana, only few references are available. Probably, Levi (1983) was the first to record *Argiope aemula* (Walckenaer, 1841) from Ambala district. Thereafter, Monga *et al.* (1988a, b) described two huntsman spiders, *Heteropoda gourae* Monga *et al.*, 1988 and *Phintelloides singhi* (Monga *et al.*, 1988a, b) from Hisar district. In the same year, Gajbe (1988) recorded four species of gnaphosid spiders, *Haplodrassus sataraensis* Tikader & Gajbe, 1977 (from Ambala), *Drassodes pashanensis* Tikader & Gajbe, 1977 (from Gurgaon), *Gnaphosa poonaensis* Tikader, 1973 and *Zelotes sataraensis* Tikader & Gajbe, 1979 (from Karnal). Thereafter, Arora & Monga (1992) described *Stegodyphus hisarensis* from Hisar, however, its specific identity seems to be doubtful as it probably belongs to either Philodromidae or Thomisidae (Siliwal *et al.*, 2005; El-Hennawy, 2016). Recently, Goyal & Malik (2017, 2020), and Goyal *et al.* (2020) recorded 45 species of spiders from three districts, Fatehabad, Hisar, and Sirsa (Table 1).

In the present compilation, a total of only 59 species described under 39 genera belonging to 16 families were enlisted that have been recorded/described from only 8 districts of Haryana giving up-to-date information in the light of modern taxonomic concepts (Table 1). Out of 22 districts of Haryana, maximum number of species of spiders were recorded from Hisar (50 species) followed by Sirsa (44 species), Fatehabad (42 species). In other districts only single or two species were recorded (Fig. 2). No faunal survey of spiders so far was conducted in 14 districts of Haryana. Hence, an intensive and extensive faunal survey is required in these areas.

Table 1. Checklist of fauna of spiders described/recorded in different districts of Haryana.

Family/Species of spiders	**Districts**	**References**
1. Araneidae		
Argiope aemula (Walckenaer, 1841)	Ambala, Bhiwani	Levi, 1983; Vats *et al.*, 2020
Cyrtophora citricola (Forsskål, 1775)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Eriovixia excelsa (Simon, 1889)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Neoscona bihumpi Patel, 1988	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Neoscona mukerjei Tikader, 1980	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Neoscona theisi (Walckenaer, 1841)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Neoscona vigilans (Blackwall, 1865)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
2. Cheiracanthiidae		
Cheiracanthium punjabense Sadana & Bajaj, 1980	Hisar	Arora & Monga, 1993
3. Eresidae		
Stegodyphus ? *hisarensis* Arora & Monga, 1992	Hisar	Arora & Monga, 1992
4. Gnaphosidae		
Drassodes pashanensis Tikader & Gajbe, 1977	Gurgaon	Gajbe UA, 1988

Family/Species of spiders	Districts	References
Gnaphosa poonaensis Tikader, 1973	Karnal	Gajbe UA, 1988
Gnaphosa rohtakensis Gajbe, 1992	Rohtak	Gajbe UA, 1992
Haplodrassus sataraensis Tikader & Gajbe, 1977	Ambala	Gajbe UA, 1988
Zelotes nainitalensis Tikader & Gajbe, 1976	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Zelotes sataraensis Tikader & Gajbe, 1979	Karnal	Gajbe UA, 1988
5. Hersiliidae		
Hersilia orvakalensis Javed, Foord & Tampal, 2010	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017; Goyal & Malik, 2018
Hersilia savignyi Lucas, 1836	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
6. Lycosidae		
Hippasa haryanensis Arora & Monga, 1994	Hisar	Arora & Monga, 1993, 1994
Lycosa bistriata Gravely, 1924	Hisar	Arora & Monga, 1993
Lycosa mackenziei Gravely, 1924	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Pardosa sumatrana (Thorell, 1890)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Pardosa tikaderi Arora & Monga, 1994	Hisar	Arora & Monga, 1993, 1994
Wadicosa fidelis (O. Pickard-Cambridge, 1872)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
7. Oecobiidae		
Oecobius navus Blackwall, 1859	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
8. Oxyopidae		
Oxyopes haryanaensis Goyal & Malik, 2020	Sirsa	Goyal & Malik, 2020
Oxyopes kohaensis Bodkhe & Vankhede, 2012	Sirsa	Goyal *et al.*, 2020
Oxyopes pankaji Gajbe & Gajbe, 2000	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
9. Pholcidae		
Artema atlanta Walckenaer, 1837	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Crossopriza lyoni (Blackwall, 1867)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
10. Salticidae		
Epocilla aura (Dyal, 1935)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Epocilla aurantiaca (Simon, 1885)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Epocilla calcarata (Karsch, 1880)	Fatehabad, Hisar, Sirsa	Malik & Goyal,

Family/Species of spiders	Districts	References
		2017
Menemerus bivittatus (Dufour, 1831)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Myrmaplata plataleoides (O. Pickard-Cambridge, 1869)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Phintelloides singhi (Monga, Singh & Sadana, 1989)	Hisar	Monga *et al.*, 1988b
Plexippus paykulli (Audouin, 1825)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Rhene danieli Tikader, 1973	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Rudakius ludhianaensis (Tikader, 1974)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Salticus scenicus (Clerck, 1757)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Thyene imperialis (Rossi 1846)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
11. Scytodidae		
Scytodes fusca Walckenaer, 1837	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Scytodes pallida Doleschall, 1859	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Scytodes thoracica (Latreille, 1802)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
12. Sparassidae		
Heteropoda gourae Monga, Sadana & Singh, 1988	Hisar	Monga *et al.*, 1988a
13. Tetragnathidae		
Guizygiella indica (Tikader & Bal, 1980)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Leucauge decorata (Blackwall, 1864)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Tetragnatha mandibulata Walckenaer, 1841	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
14.Theridiidae		
Latrodectus hasselti Thorell, 1870	Hisar	Goyal & Malik, 2017
15. Thomisidae		
Runcinia insecta (L. Koch, 1875)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Runcinia roonwali Tikader, 1965	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Tharrhalea evanida (L. Koch, 1867)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Thomisus pooneus Tikader, 1965	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Thomisus projectus Tikader, 1960	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Thomisus shivajiensis Tikader, 1965	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017
Thomisus unidentatus Dippenaar-Schoeman & van Harten, 2007	Gurgaon	Diksha *et al.*, 2018
16. Uloboridae		
Uloborus danolius Tikader, 1969	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017)

Family/Species of spiders	Districts	References
Uloborus krishnae Tikader, 1970	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017)
Uloborus plumipes Lucas, 1846	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017)
Zosis geniculata (Olivier, 1789)	Fatehabad, Hisar, Sirsa	Malik & Goyal, 2017)

B. Himachal Pradesh

Himachal Pradesh (latitude: 30°22' to 33°12'N, altitude: 75°47' to 79°04'E) is a northwest Indian state located in the Western Himalayas having the total geographical area of 55,673 km^2 and is spread across valleys having several peaks with many perennial rivers flowing through them. Himachal Pradesh shares borders with the Jammu & Kashmir and Ladakh to the north, Punjab to the west, Haryana to the southwest, Uttarakhand to the southeast, a very narrow border with Uttar Pradesh to the south and China (Tibet Autonomous Region) to the east (Fig. 3). In 1966, some parts of Punjab (Simla, Kangra, Kullu and Lahaul & Spiti districts, Lohara, Amb and Una Kanungo circles, some area of Santokhgarh Kanungo circle and some other specified area of Una tehsil of Hoshiarpur district, Kandaghat and Nalagarh tehsils, some parts of Dhar Kalan Kanungo circle of Pathankot district) were merged into Himachal Pradesh in 1966. The drainage system of Himachal Pradesh is composed both of perennial rivers fed by snow and rainfall and glaciers and provides water to both the Indus and Ganges basins. The rivers are the Chenab, the Ravi, the Beas, the Sutlej, and the Yamuna. The climate varies from hot and humid subtropical in the southern tracts to, with more elevation, cold, alpine, and glacial in the northern and eastern mountain ranges. About 66.5% of the area of Himachal Pradesh is covered with forest with rich flora and fauna. There are several widespread orchards, meadows, pastures, wildlife sanctuaries, and national parks in the state. Himachal Pradesh is administratively divided in 12 districts (Fig. 3).

Probably, Pocock (1900) was the first to record two species of spiders, *Plator indicus* Simon, 1897 from Chamba district; *Heteropoda phasma* Simon, 1897 from Solan district from Himachal Pradesh. Thereafter, Gravely (1924, 1931) described a lycosid spider, *Pardosa fletcheri* (Gravely, 1924) and recorded two more species, *Heteropoda leprosa* Simon, 1884 and *Pseudopoda prompta* (O. Pickard-Cambridge, 1885) from Himachal Pradesh. After two decades, Sinha (1951) mentioned another lycosid, *Lycosa phipsoni* Pocock, 1899 from Shimla. In later years, a number of workers described/recorded several species of spiders at regular interval from different localities of Himachal Pradesh as mentioned below (Table 2). During the last two years, three species of spiders were described by Zamani & Marusik (2020) (*Araniella levii*, *Araniella maasdorpi*, *Araniella villanii*) from Lahaul & Spiti district and two species by Lin *et al.* (2021) (*Pimoa gagna* Zhang & Li, 2021; *Pimoa shoja* Zhang & Li, 2021) from Shimla and Kullu districts. However, no faunal survey programme was yet conducted in the state to study the distribution of spiders.

In the present compilation, a total of 90 species described under 58 genera belonging to 22 families were enlisted that have been recorded/described from Himachal Pradesh giving up-to-date information in the light of modern taxonomic concept (Table 2). Out of 12 districts of Himachal Pradesh, most of the spiders were recorded from Kullu (25 species) followed by Lahual & Spiti (21 species), Shimla (17 species), Solan (15 species), Chamba (12 species), Sirmaur (10 species), Bilaspur (8 species), Kangra (6 species), and Kinnaur (4 species) districts. No spider was so far collected from 2 districts of Himachal

Pradesh, Hamirpur, and Una (Fig. 3). Hence, intensive and extensive faunal survey is required in these areas as spiders are very common and found every where.

Fig. 3. Map of Himachal Pradesh showing the number of species of spiders described/recorded from different districts.

Following is the list of species of spiders recorded/described from different districts of Himachal Pradesh.

Table 2. Checklist of fauna of spiders described/recorded in different districts of Himachal Pradesh.

Families/Species	Districts	References
1. Amaurobiidae		
Amaurobius jugorum L. Koch, 1868	Lahaul & Spiti	Marusik *et al.*, 2012
2. Araneidae		
Araniella levii Zamani & Marusik, 2020	Lahaul & Spiti	Zamani & Marusik, 2020
Araniella maasdorpi Zamani & Marusik, 2020	Lahaul & Spiti	Zamani & Marusik, 2020
Araniella villanii Zamani, Marusik & Šestáková, 2020	Lahaul & Spiti	Zamani *et al.*, 2020
Argiope pulchella Thorell, 1881	Kullu	Levi, 1983
Gea spinipes C.L. Koch, 1843	Sirmaur	Chakrabarti, 2009
Gibbaranea bituberculata (Walckenaer, 1802)	Kullu	Tikader & Biswas, 1981; Tikader, 1982

Families/Species	Districts	References
Neoscona theisi (Walckenaer, 1841)	Kullu	Zamani *et al.*, 2020
Neoscona sp.	Lahaul & Spiti	Uniyal, 2006
3. Cheiracanthiidae		
Cheiracanthium approximatum O. Pickard-Cambridge, 1885	Kullu	Marusik *et al.*, 2020
4. Ctenidae		
Amauropelma beyersdorfi Jäger, 2012	Shimla	Jäger, 2012
5. Gnaphosidae		
Drassodes deoprayagensis Tikader & Gajbe, 1975	Solan	Tikader, 1982; Gajbe UA, 1988
Drassodes gangeticus Tikader & Gajbe, 1975	Bilaspur	Gajbe UA, 1988
Drassodes himalayensis Tikader & Gajbe, 1975	Bilaspur, Kangra, Mandi, Sirmaur	Gajbe UA, 1988
Drassodes parvidens Caporiacco, 1934	Lahaul & Spiti	Bastawade, 2008
Drassodes pashanensis Tikader & Gajbe, 1977	Sirmaur	Gajbe UA, 1988
Drassodes sirmourensis (Tikader & Gajbe, 1977)	Lahaul & Spiti, Sirmaur	Tikader, 1982; Bastawade, 2008
Drassodes sitae Tikader & Gajbe, 1975	Bilaspur, Kangra, Kinnaur	Gajbe UA, 1988
Drassodes tikaderi (Gajbe, 1987)	Solan	Gajbe UA, 1987
Gnaphosa dege Ovtsharenko, Platnick & Song, 1992	Lahaul & Spiti	Marusik *et al.*, 2014
Gnaphosa pauriensis Tikader & Gajbe, 1977	Bilaspur, Kangra, Mandi	Gajbe UA, 1988, 2005
Gnaphosa poonaensis Tikader, 1973	Kullu, Kinnaur, Solan	Tikader, 1982; Gajbe UA, 1988
Gnaphosa sp.	Lahaul & Spiti	Uniyal, 2006
Haplodrassus sataraensis Tikader & Gajbe, 1977	Bilaspur, Kangra, Sirmaur	Gajbe UA, 1988
Micaria pulcherrima Caporiacco, 1935	Lahaul & Spiti	Marusik *et al.*, 2014
Scotophaeus madalasae Tikader & Gajbe, 1977	Bilaspur, Solan	Gajbe UA, 1988
Scotophaeus simlaensis Tikader, 1982	Shimla	Tikader, 1982
Setaphis browni (Tucker, 1923)	Bilashpur	Tikader & Gajbe, 1977a; Tikader, 1982
Setaphis solanensis (Tikader & Gajbe, 1977)	Solan	Tikader & Gajbe, 1977b; Tikader, 1982; Sankaran *et al.*, 2020a
Urozelotes pawani (Gajbe, 1993)	Solan	Gajbe UA, 1993); Sankaran & Caleb, 2021
Zelotes mandlaensis Tikader & Gajbe, 1976	Solan	Gajbe UA, 1988
Zelotes sataraensis Tikader & Gajbe, 1979	Sirmaur	Gajbe UA, 1988
6. Linyphiidae		
Caviphantes pseudosaxetorum Wunderlich, 1979	Kullu, Mandi	Tanasevitch, 2011, 2019
Erigone rohtangensis Tikader, 1981	Kullu	Tikader, 1981a
Gongylidiellum confusum Thaler, 1987	Shimla	Tanasevitch, 2011
Gongylidioides pectinatus Tanasevitch, 2011	Mandi	Tanasevitch, 2011

Families/Species	Districts	References
Indophantes digitulus (Thaler, 1987)	Chamba, Kullu	Tanasevitch, 2011
Oedothorax paralegrandi Tanasevitch, 2016	Chamba	Tanasevitch, 2016
Pelecopsis indus Tanasevitch, 2011	Kullu	Tanasevitch, 2011
Scotargus pilosus Simon, 1913	Kullu	Tanasevitch, 2011
Tiso incisus Tanasevitch, 2011	Kullu, Shimla	Tanasevitch, 2011
7. Liocranidae		
Sphingius solanensis (Gajbe, 1979)	Solan	Gajbe UA, 1979; Tikader, 1982; Sankaran & Caleb, 2021
8. Lycosidae		
Arctosa sp.	Lahaul & Spiti	Uniyal, 2006
Evippa sohani Tikader & Malhotra, 1980	Lahaul & Spiti	Uniyal, 2006
Evippa solanensis Tikader & Malhotra, 1980	Chamba	Tikader & Malhotra, 1980; Dhali *et al.*, 2016a
Hippasa himalayensis Gravely, 1924	Shimla	Dhali *et al.*, 2016b; Saha *et al.*, 2016
Lycosa bistriata Gravely, 1924	Sirmaur	Prasad *et al.*, 2021
Lycosa mackenziei Gravely, 1924	Chamba	Tikader & Malhotra, 1980; Tikader & Biswas, 1981
Lycosa nigrotibialis Simon, 1884	Shimla	Tikader & Malhotra, 1980
Lycosa phipsoni Pocock, 1899	Shimla	Sinha, 1951
Lycosa prolifica Pocock, 1901	Kangra	Tikader & Malhotra, 1980
Pardosa chambaensis Tikader & Malhotra, 1976	Chamba	Tikader & Malhotra, 1976, 1980
Pardosa fletcheri (Gravely, 1924)	Kangra, Shimla, Solan	Gravely, 1924; Sinha, 1951; Tikader & Malhotra, 1980
Pardosa minuta Tikader & Malhotra, 1976	Chamba, Lahaul & Spiti	Tikader & Malhotra, 1976, 1980; Biswas and Biswas, 2004; Bastawade, 2008
Pardosa sumatrana (Thorell, 1890)	Shimla, Solan	Sinha, 1951; Tikader, 1977; Tikader & Malhotra, 1980
Wadicosa fidelis (O. Pickard-Cambridge, 1872)	Chamba, Kangra, Sirmaur, Solan	Tikader & Malhotra, 1980
9. Oonopidae		
Camptoscaphiella fulva Caporiacco, 1934	Shimla	Baehr & Ubick, 2010
Camptoscaphiella gunsa Baehr, 2010	Chamba	Baehr & Ubick, 2010
10. Pholcidae		
Belisana marusiki Huber, 2005	Kullu	Huber, 2005
Pholcus djelalabad Senglet, 2008	Kullu	Huber, 2011
11. Pimoidae		
Pimoa gagna Zhang & Li, 2021	Shimla	Lin *et al.*, 2021
Pimoa shoja Zhang & Li, 2021	Kullu	Lin *et al.*, 2021
12. Psechridae		
Psechrus himalayanus Simon, 1906	Kullu	Levi, 1982; Bayer, 2012
13. Salticidae		
Aelurillus improvisus Azarkina, 2002	Kullu	Azarkina, 2002
Aelurillus minimontanus Azarkina, 2002	Kullu, Lahaul & Spiti	Azarkina, 2002
Bianor albobimaculatus (Lucas, 1846)	Kullu	Logunov, 2000

Families/Species	Districts	References
Bianor angulosus (Karsch, 1879)	Kullu	Logunov, 2000
Chinattus validus (Xie, Peng & Kim, 1993)	Kullu	Logunov, 2021a
Marpissa sp.	Bilaspur, Lahaul & Spiti	Uniyal, 2006
Phlegra fasciata (Hahn, 1826)	Lahaul & Spiti	Logunov & Koponen, 2002
14. Selenopidae		
Makdiops montigena (Simon, 1889)	Kullu	Crews & Harvey, 2011
15. Sparassidae		
Heteropoda afghana Roewer, 1962	Kullu	Roewer, 1962; Jäger, 2005
Heteropoda kuluensis Sethi & Tikader, 1988	Kullu	Sethi & Tikader, 1988
Heteropoda leprosa Simon, 1884	Shimla, Solan	Gravely, 1931
Heteropoda phasma Simon, 1897	Solan	Pocock, 1900; Sethi & Tikader, 1988
Pseudopoda cf. *casaria* (Simon, 1897)	Chamba, Shimla	Jäger, 2001, 2008
Pseudopoda prompta (O. Pickard-Cambridge, 1885)	Shimla	Gravely, 1931; Sethi & Tikader, 1988
16. Tetragnathidae		
Leucauge fastigata (Simon, 1877)	Lahaul & Spiti	Bastawade, 2008
Meta simlaensis Tikader, 1982	Kinnaur, Shimla	Tikader, 1982
17. Theraphosidae		
Haplocosmia himalayana (Pocock, 1899)	Chamba, Solan	Husain, 2020
Selenocosmia kulluensis Chamberlin, 1917	Kullu	Siliwal *et al.*, 2011
18. Theridiidae		
Achaearanea budana Tikader, 1970	Lahaul & Spiti	Uniyal, 2006
Enoplognatha diodonta Zhu & Zhang, 1992	Kullu	Marusik *et al.*, 2014
Episinus pentagonalis Chakrabarti, 2013	Shimla, Sirmaur	Chakrabarti, 2013
Theridion sp.	Lahaul & Spiti	Uniyal, 2006
19. Thomisidae		
Tharpyna himachalensis Tikader & Biswas, 1979	Kinnaur	Tikader & Biswas, 1979
Xysticus sp.	Lahaul & Spiti	Uniyal, 2006
20. Titanoecidae		
Titanoeca sharmai (Bastawade, 2008)	Lahaul & Spiti	Bastawade, 2008
21. Trochanteriidae		
Plator indicus Simon, 1897	Chamba	Pocock, 1900
Plator pandeae Tikader, 1969	Chamba	Sankaran *et al.*, 2020b)
Plator solanensis Tikader & Gajbe, 1976	Sirmaur, Solan	Tikader & Gajbe, 1976; Sankaran *et al.*, 2020b
22. Uloboridae		
Hyptiotes himalayensis Tikader, 1981	Shimla	Tikader, 1981b

C. Punjab

Punjab (latitude: 29°30’ to 32°32’N, longitude: 73°55’ to 76°50’E) is also one of the landlocked north Indian states having the total geographical area of 50,362 km^2. Punjab is divided into 23 districts (Fig. 4). It is bordered by the states of Himachal Pradesh to the north and northeast, Haryana to the south and southeast, and Rajasthan to the southwest, by the union territory of Chandigarh (also the capital of Punjab and Haryana) to the east, and by Jammu and Kashmir to the north, by Punjab (a province of

Pakistan) to the west (Fig. 4). In 1966, Haryana was carved out from the Punjab state while the hilly regions merged into Himachal Pradesh. Most of the Punjab lies in a fertile, alluvial plain with several rivers. The five tributary rivers of the Indus river from which the region took its name are the Sutlej, Ravi, Beas, Chenab and Jhelum out of which the first three rivers flow through the Indian Punjab. The northeastern part of the Punjab at the foot of the Himalayas is hilly with an average elevation of 300 m (180 to 500 m) above sea level. The southwest of the state is semiarid and merged into the Thar Desert. Punjab experiences its maximum temperatures (above 40°C) in mid-May and June and minimum temperature (below 5°C) from December to February with an average annual rainfall around 650 mm. Punjab has large wetland areas, wildlife sanctuaries, many zoological parks and gardens.

Fig. 4. Map of Punjab showing the number of species of spiders described/recorded from different districts.

Probably, Dyal (1957) was the first to describe a species of spider, *Sivalicus viridis* from Hoshiarpur, Punjab. Later, Tikader (1966) mentioned *Artema atlanta* Walckenaer, 1837 to be distributed in Punjab. Thereafter, few workers described many species of spiders from Punjab, e.g. *Cheiracanthium sadanai* Tikader, 1976; *Clubiona ludhianaensis* Tikader, 1976; *Cheiracanthium punjabense* Sadana & Bajaj, 1980; *Lycosa bhatnagari* Sadana, 1969; *Phidippus bengalensis* Tikader, 1977; *Phidippus punjabensis* Tikader, 1974; *Rhene indica* Tikader, 1973; *Rudakius ludhianaensis* (Tikader, 1974);

Chorizopes tikaderi Sadana & Kaur, 1974. In later years, Tikader & Biswas (1981), Kumari (1982, 1983, 1984), Gajbe UA (1988, 1992, 2008), Sadana (1991), Sadana & Goel (1995), Kumari & Mittal (1997, 1999), Logunov (2000), and Kronestedt (2010) described/recorded several species of spiders from different localities of Punjab.

In recent years, Anjali *et al.* (2019) accounted 27 species of spiders from Kapurthala and Ludhiana districts; Caleb (2020) mentioned one species from Punjab (locality not mentioned); Chaudhary (2020) reported 10 species from Ludhiana district; Singh S *et al.* (2020) recorded 34 species of spiders from fruit crops in different districts of Punjab; Zamani *et al.* (2020) mentioned one species from Patiala district; Chandra *et al.* (2021) reported 3 species from wetland of Firozepur district; and very recently, Logunov (2021b) mentioned one species from Punjab (locality not mentioned).

In the present compilation, a total of 109 species described under 64 genera belonging to 19 families were enlisted that have been described/recorded from Punjab giving up-to-date information in the light of modern taxonomic concept (Table 3). Out of 23 districts of Punjab, most of the spiders were recorded from Ludhiana (85 species) followed by Patiala (43 species), Hoshiarpur (30 species), Kapurthala (27 species), Firozepur (14 species), Bathinda (8 species), Gurdaspur (7 species), Rupnagar (3 species), Fatehgarh Sahib (2 species), Amritsar and Mansa (1 species each) districts. No spider was so far collected from 12 districts of Punjab (Barnala, Faridkot, Fazilka, Jalandhar, Moga, Muktsar, Nawanshahr (Shahid Bhagat Singh Nagar), Pathankot, Sahibzada Ajit Singh Nagar (Mohali), Sangrur, Tarn Taran and Malerkotla districts) (Fig. 4). Hence, intensive and extensive faunal survey is required in these areas as spiders are very common and found every where.

The distribution of few species of spiders are erroneously/inadvertently mentioned in Punjab, e.g. *Drassodes sitae* Tikader & Gajbe, 1975 (Gajbe UA, 1988), *Gnaphosa kailana* Tikader, 1966 (Tikader, 1982), *Idiops designatus* O. Pickard-Cambridge, 1885 (Dhali *et al.*, 2016a), *Evippa praelongipes* (O. Pickard-Cambridge, 1871) (Tikader & Malhotra, 1980), *Lycosa mackenziei* Gravely, 1924 (Dyal, 1935; Biswas & Biswas, 1992; Sen *et al.*, 2015; Dhali *et al.*, 2016a), *Pardosa fletcheri* (Gravely, 1924) (Tikader & Malhotra, 1980), *Pardosa pseudoannulata* (Bösenberg & Strand, 1906) (Tikader, 1964), *Peucetia punjabensis* Gajbe, 1999 (Gajbe UA, 1999, 2008), *Scytodes propinqua* Stoliczka, 1869 (Majumder, 2005; Gajbe UA, 2007), *Olios tener* (Thorell, 1891) (Gravely, 1931), *Spariolenus tigris* Simon, 1880 (Biswas & Biswas, 2004; Majumder, 2005), and *Thomisus pugilis* Stoliczka, 1869 (Tikader, 1971, 1980a; Tikader & Biswas, 1981; Majumder, 2005; Gajbe UA, 2007; Caleb, 2020). Indeed, these species were reported from different places of Punjab province of Pakistan not of India.

Following is the list of species of spiders recorded/described from different districts of Punjab.

Table 3. Checklist of fauna of spiders described/recorded in different districts of Punjab.

Family/Species of spiders	Districts	References
1. Araneidae		
Araneus bilunifer Pocock, 1900	Patiala, Hoshiarpur, Ludhiana	Kumari, 1982, 1983
Araneus ellipticus (Tikader & Bal, 1981)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Araneus mitificus (Simon, 1886)	Firozepur, Hoshiarpur, Ludhiana, Patiala	Kumari, 1982; Singh S *et al.*, 2020
Araneus sp.	Ludhiana	Bhathal *et al.*, 1990
Argiope aemula (Walckenaer, 1841)	Patiala, Ludhiana	Kumari, 1982, 1983;

Family/Species of spiders	Districts	References
		Chaudhary, 2020
Argiope pulchella Thorell, 1881	Ludhiana, Kapurthala	Anjali *et al.*, 2019
Argiope sp.	Bathinda, Firozepur, Hoshiarpur, Ludhiana, Mansa	Singh S *et al.*, 2020
Chorizopes tikaderi Sadana & Kaur, 1974	Patiala, Ludhiana	Sadana & Kaur, 1974a; Kumari, 1982, 1983
Cyclosa insulana (Costa, 1834)	Patiala	Kumari, 1982, 1983
Cyclosa moonduensis Tikader, 1963	Patiala,	Kumari, 1982, 1983
Cyclosa sp.	Ludhiana, Kapurthala	Anjali *et al.*, 2019
Cyrtophora cicatrosa (Stoliczka, 1869)	Patiala,	Kumari, 1982, 1983
Cyrtophora citricola (Forsskål, 1775)	Patiala	Tikader & Biswas, 1981; Kumari, 1982
Eriovixia excelsa (Simon, 1889)	Patiala	Kumari, 1982, 1983
Gasteracantha cancriformis (Linnaeus, 1758)	Bathinda, Firozepur, Hoshiarpur	Singh S *et al.*, 2020
Neoscona bengalensis Tikader & Bal, 1981	Bathinda, Firozepur, Ludhiana	Singh S *et al.*, 2020
Neoscona mukerjei Tikader, 1980	Bathinda, Firozepur, Hoshiarpur, Kapurthala, Ludhiana, Patiala	Anjali *et al.*, 2019; Chaudhary, 2020; Singh S *et al.*, 2020
Neoscona nautica (L. Koch, 1875)	Patiala, Ludhiana	Kumari, 1982, 1983; Bhathal *et al.*, 1990
Neoscona punctigera (Doleschall, 1857)	Bathinda, Firozepur, Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Neoscona theisi (Walckenaer, 1841)	Bathinda, Firozepur, Hoshiarpur, Kapurthala, Ludhiana, Patiala	Anjali *et al.*, 2019; Chaudhary, 2020; Singh S *et al.*, 2020; Zamani *et al.*, 2020
Neoscona vigilans (Blackwall, 1865)	Patiala	Kumari, 1982, 1983
Neoscona sp.	Bathinda, Fatehgarh Sahib, Firozepur, Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Nephila pilipes (Fabricius, 1793)	Firozepur	Chandra *et al.*, 2021
Poltys sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Porcataraneus bengalensis (Tikader, 1975)	Ludhiana	Chaudhary, 2020
2. Cheiracanthiidae		
Cheiracanthium punjabense Sadana & Bajaj, 1980	Patiala, Ludhiana	Sadana & Bajaj, 1980; Kumari, 1982, 1983
Cheiracanthium sadanai Tikader, 1976	Ludhiana	Tikader, 1976
Cheiracanthium sp.	Ludhiana	Singh S *et al.*, 2020
3. Clubionidae		
Clubiona abboti L. Koch, 1866	Ludhiana	Kumari, 1982; Singh & Mavi, 1984
Clubiona drassodes O. Pickard-Cambridge, 1874	Ludhiana	Singh, 1970

Family/Species of spiders	Districts	References
Clubiona ludhianaensis Tikader, 1976	Ludhiana	Tikader, 1976
Clubiona sp.	Ludhiana, Patiala	Singh S *et al.*, 2020
Elaver excepta (L. Koch, 1866)	Patiala,	Kumari, 1983
4. Eresidae		
Stegodyphus sarasinorum Karsch, 1892	Kapurthala, Ludhiana	Kumari, 1982; Anjali *et al.*, 2019
5. Gnaphosidae		
Callilepis lambai Tikader & Gajbe, 1977	Hoshiarpur	Gajbe UA, 1988
Drassodes pashanensis Tikader & Gajbe, 1977	Rupnagar	Gajbe UA, 1988
Drassodes sirmourensis (Tikader & Gajbe, 1977)	Firozepur	Chandra *et al.*, 2021
Gnaphosa jodhpurensis Tikader & Gajbe, 1977	Hoshiarpur	Gajbe UA, 1988
Gnaphosa pauriensis Tikader & Gajbe, 1977	Gurdaspur	Gajbe UA, 1988
Gnaphosa poonaensis Tikader, 1973	Bathinda, Firozepur	Gajbe UA, 1988
Haplodrassus ambalaensis Gajbe, 1992	Rupnagar	Gajbe UA, 1992
Haplodrassus sataraensis Tikader & Gajbe, 1977	Hoshiarpur, Rupnagar	Gajbe UA, 1988
6. Hersiliidae		
Hersilia savignyi Lucas, 1836	Gurdaspur, Hoshiarpur, Kapurthala, Ludhiana, Patiala	Kumari, 1982; Anjali *et al.*, 2019; Singh S *et al.*, 2020
7. Linyphiidae		
Linyphia sp.	Ludhiana	Bhathal *et al.*, 1990
8. Lycosidae		
Draposa oakleyi (Gravely, 1924)	Ludhiana, Patiala	Kronestedt, 2010
Hippasa agelenoides (Simon, 1884)	Kapurthala, Ludhiana, Patiala	Kumari, 1982; Anjali *et al.*, 2019
Hippasa holmerae Thorell, 1895	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Lycosa bhatnagari Sadana, 1969	Ludhiana	Sadana, 1969
Lycosa mackenziei Gravely, 1924	Ludhiana	Chaudhary, 2020
Lycosa wroughtoni Pocock, 1899	Ludhiana	Sadana, 1981
Pardosa sumatrana (Thorell, 1890)	Ludhiana	Chaudhary, 2020
Pardosa sp.	Ludhiana	Singh S *et al.*, 2020
Wadicosa fidelis (O. Pickard-Cambridge, 1872)	Kapurthala, Ludhiana, Patiala	Sadana, 1971; Tikader & Malhotra, 1980; Kumari, 1983;Anjali *et al.*, 2019
9. Oonopidae		
Oonops sp.	Patiala	Kumari, 1982
10. Oxyopidae		
Oxyopes ashae Gajbe, 1999	Gurdaspur, Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Oxyopes birmanicus Thorell, 1887	Gurdaspur, Hoshiarpur,	Chaudhary, 2020;

Family/Species of spiders	Districts	References
	Ludhiana	Singh S *et al.*, 2020
Oxyopes gurjanti Sadana & Gupta, 1995	Ludhiana	Sadana & Gupta, 1995; Gajbe UA, 2008
Oxyopes javanus Thorell, 1887	Gurdaspur, Hoshiarpur, Kapurthala, Ludhiana	Anjali *et al.*, 2019; Singh S *et al.*, 2020
Oxyopes ludhianaensis Sadana & Goel, 1995	Ludhiana	Sadana & Goel, 1995; Gajbe UA, 2008
Oxyopes pandae Tikader, 1969	Patiala	Kumari, 1982, 1983; Bhathal *et al.*, 1990
Oxyopes ratnae Tikader, 1970	Ludhiana	Sadana & Gupta, 1995; Gajbe UA, 2008
Oxyopes shweta Tikader 1970	Amritsar, Gurdaspur, Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Oxyopes sp.	Fatehgarh Sahib, Patiala	Singh S *et al.*, 2020
Peucetia sp.	Ludhiana, Patiala	Singh S *et al.*, 2020
11. Philodromidae		
Philodromus sp.	Kapurthala, Ludhiana	Bhathal *et al.*; 1990Anjali *et al.*, 2019
12. Pholcidae		
Artema atlanta Walckenaer, 1837	Punjab	Tikader & Biswas, 1981; Majumder and Biswas, 1992; Majumder, 2005
Crossopriza lyoni (Blackwall, 1867)	Patiala	Tikader & Biswas, 1981; Kumari, 1982
13. Pisauridae		
Perenethis venusta L. Koch, 1878	Ludhiana	Chaudhary, 2020
14. Salticidae		
Bianor albobimaculatus (Lucas, 1846)	Patiala	Logunov, 2000
Bianor angulosus (Karsch, 1879)	Punjab	Logunov, 2000
Bianor punjabicus Logunov, 2001	Patiala	Logunov, 2000
Bianor sp.	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Carrhotus viduus (C.L. Koch, 1846)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Epeus flavobilineatus (Doleschall, 1859)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Epocilla aura (Dyal, 1935)	Patiala, Hoshiarpur, Ludhiana	Tikader & Biswas, 1981; Kumari, 1983, 1984; Majumder, 2005
Epocilla aurantiaca (Simon, 1885)	Ludhiana, Kapurthala	Anjali *et al.*, 2019
Epocilla calcarata (Karsch, 1880)	Gurdaspur, Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Harmochirus zabkai Logunov, 2001	Patiala	Logunov, 2000
Hyllus semicupreus (Simon, 1885)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Hyllus sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Menemerus semilimbatus (Hahn, 1829)	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Modunda staintoni (O. Pickard-Cambridge, 1872)	Patiala	Logunov, 2000

Family/Species of spiders	Districts	References
Myrmarachne laeta (Thorell, 1887)	Ludhiana	Sadana & Gupta, 1998
Myrmarachne ludhianaensis Sadana & Gupta, 1998	Ludhiana	Sadana & Gupta, 1998
Myrmarachne melanocephala MacLeay, 1839	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Myrmarachne prava (Karsch, 1880)	Patiala	Kumari, 1982, 1983
Phidippus bengalensis Tikader, 1977	Ludhiana, Patiala	Tikader & Biswas, 1981; Kumari, 1983, 1984; Majumder, 2005
Phidippus punjabensis Tikader, 1974	Ludhiana	Tikader, 1974a
Phidippus sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Phintella vittata (C.L. Koch, 1846)	Hoshiarpur, Ludhiana	Tikader & Biswas, 1981; Majumder, 2005; Singh S *et al.*, 2020
Plexippus paykulli (Audouin, 1825)	Firozepur, Hoshiarpur, Ludhiana	Kumari, 1982, 1984; Chaudhary, 2020; Singh S *et al.*, 2020
Plexippus petersi (Karsch, 1878)	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Rhene citri (Sadana, 1991)	Ludhiana	Sadana, 1991
Rhene indica Tikader, 1973	Ludhiana	Tikader, 1973
Rhene khandalaensis Tikader, 1977	Ludhiana, Patiala	Kumari, 1983, 1984
Rudakius ludhianaensis (Tikader, 1974)	Ludhiana, Patiala	Tikader, 1974b; Sadana & Kaur, 1974b; Sadana, 1980; Kumari, 1982, 1983, 1984
Salticus scenicus (Clerck, 1757)	Ludhiana, Patiala	Kumari, 1983, 1984; Bhathal *et al.*, 1990
Telamonia dimidiata (Simon, 1899)	Firozepur, Hoshiarpur, Kapurthala, Ludhiana	Anjali *et al.*, 2019; Singh S *et al.*, 2020
Telamonia elegans (Thorell, 1887)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020
Telamonia festiva Thorell, 1887	Ludhiana, Patiala	Kumari, 1983, 1984
Thyene imperialis (Rossi, 1846)	Punjab	Caleb, 2020; Logunov, 2021b
15. Selenopidae		
Selenops radiatus Latreille, 1819	Patiala	Kumari, 1982, 1983
Selenops sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019
16. Sparassidae		
Heteropoda sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019; Singh S *et al.*, 2020
Olios milleti (Pocock, 1901)	Kapurthala, Ludhiana	Anjali *et al.*, 2019; Singh S *et al.*, 2020
Olios obesulus (Pocock, 1901)	Patiala	Kumari, 1982, 1983
Sivalicus viridis Dyal, 1957	Hoshiarpur	Dyal, 1957
17. Tetragnathidae		
Guizygiella indica (Tikader & Bal, 1980)	Ludhiana, Kapurthala	Anjali *et al.*, 2019
Leucauge celebesiana (Walckenaer,1841)	Hoshiarpur, Ludhiana	Singh S *et al.*, 2020

Family/Species of spiders	Districts	References
Leucauge decorata (Blackwall, 1864)	Firozepur, Hoshiarpur, Kapurthala, Ludhiana, Patiala	Kumari, 1982; Anjali *et al.*, 2019; Singh S *et al.*, 2020; Chandra *et al.*, 2021
Tetragnatha mandibulata Walckenaer, 1841	Patiala	Kumari, 1982, 1983
Tetragnatha sp.	Kapurthala, Ludhiana	Bhathal *et al.* 1990; Anjali *et al.*, 2019
18. Thomisidae		
Indoxysticus minutus (Tikader, 1960)	Patiala	Kumari, 1982, 1983
Misumena sp.	Kapurthala, Ludhiana	Anjali *et al.*, 2019
Pistius tikaderi Kumari & Mittal, 1999	Patiala	Kumari & Mittal, 1999
Thomisus dyali Kumari & Mittal, 1997	Ludhiana	Kumari & Mittal, 1997
Thomisus lobosus Tikader, 1965	Kapurthala, Ludhiana	Anjali *et al.*, 2019; Chaudhary, 2020; Singh S *et al.*, 2020
Thomisus ludhianaensis Kumari & Mittal, 1997	Ludhiana	Kumari & Mittal, 1997
Thomisus shivajiensis Tikader, 1965	Ludhiana	Kumari, 1982; Singh & Mavi, 1984
Tmarus kotigeharus Tikader, 1963	Patiala	Kumari, 1982, 1983
Xysticus sp.	Ludhiana	Bhathal *et al.*, 1990
19. Uloboridae		
Zosis geniculata (Olivier, 1789)	Ludhiana	Singh S *et al.*, 2020

D. Chandigarh

Located near the foothills of the Shivalik range of the Himalayas in the north, Chandigarh (latitude: 30.74°N, longitude: 76.79°E) is one of the planned city, district and union territory in India having 114 km^2 area with an average elevation of 321 m and is the capital of the two neighbouring states, Punjab and Haryana. It is bordered by the state of Haryana to the east and by the state of Punjab to the north, the west and the south. Most of the area is plain, flat and fertile land. Chandigarh has a humid subtropical climate with very hot summer (upto 45°C) but mild winter. The average annual rainfall is 111 cm. Most of Chandigarh is covered with trees. There are several gardens and lakes in the city.

Regarding the spider taxonomy, probably Tikader (1971) was first to mention a thomisid spider, *Monaeses parvati* Tikader, 1963 followed by Sadana (1972) who reported the presence of *Lycosa chaperi* Simon, 1885 in Chandigarh. Bradoo (1980) was the first who described first spider species, *Myrmarachne platypalpa* from Chandigarh. Thereafter, Kumari & Mittal (1994) described another species of thomisid spider, *Misumena ganpatii.* In the recent century, only three species are recorded from Chandigarh, *Cheiracanthium approximatum* O. Pickard-Cambridge, 1885 by Marusik *et al.* (2020), *Neriene macella* (Thorell, 1898) by Tanasevitch (2017) and *Draposa oakleyi* (Gravely, 1924) by Kronestedt (2010). Thus, there are only seven species of spiders are reported to occur in Chandigarh (Table 4) which demonstrate that an extensive and intensive survey programmme is required to document the fauna of spiders in this union territory.

Table 4. Checklist of fauna of spiders described/recorded in Chandigarh.

Family/Species	References
1. Cheiracanthiidae	
Cheiracanthium approximatum O. Pickard-Cambridge, 1885	Marusik *et al.*, 2020
2. Linyphiidae	
Neriene macella (Thorell, 1898)	Tanasevitch, 2017
3. Lycosidae	
Draposa oakleyi (Gravely, 1924)	Kronestedt, 2010
Lycosa chaperi Simon, 1885	Sadana, 1972; Tikader & Malhotra, 1980
4. Salticidae	
Myrmarachne platypalpa Bradoo, 1980	Bradoo, 1980
5. Thomisidae	
Misumena ganpatii Kumari & Mittal, 1994	Kumari & Mittal, 1994
Monaeses parvati Tikader, 1963	Tikader, 1971

E. Delhi

Delhi (officially the National Capital Territory (NCT) of Delhi), located on the Yamuna river in Northern India (latitude: 28°37' to 28°61'N, longitude: 77°14' to 77°23'E), is a city and a union territory of India. It is bordered on its northern, western, and southern sides by the state of Haryana and to the east by that of Uttar Pradesh (Fig. 5). NCT covers an area of 1,484 km^2. Delhi is characterized by having one of the unique urban habitats and one of the few metros in the world that enjoy a city forest and the Delhi ridge at the bank of Yamuna river which is most significant physiographic feature of Delhi that originates from the Mewat branch of Aravalli in the south and encircles the west, northeast, and northwest parts of the city. It reaches a height of 318 m (Thapliyal, 1987). In addition to the wetlands formed by the Yamuna river, there are more than 500 ponds in Delhi. Delhi has a dry-winter humid subtropical climate that borders a hot semi-arid climate. Average temperature varies from 2°C to 14°C in winter and 28°C to 40°C in summer with an annual rainfall of 886 mm most of which falls during the monsoon in July and August. Delhi is divided into 11 administrrative districts (Fig. 5).

In spite of having several agricultural, ecological and academic institutions in Delhi, only little serious work on taxonomy and faunal distribution of spiders was conducted in this region (Biswas & Biswas, 1997; Das & Singh, 2012; Malik *et al.*, 2015, 2016a, b, 2017, 2018). Blackwall (1867) was the first to describe four species of spiders, *Hippasa greenalliae* (as *Lycosa greenalliae*), *Drassodes delicatus* (as *Drassus delicatus*), *Crossopriza lyoni* (as *Pholcus lyoni*), and *Olios striatus* (as *Sparassus striatus*, Jäger (2020) considered it *nomen dubium*) from Delhi, Meerut and Agra. After a long gap of 113 years, Sharma & Sarup (1980) studied the predatory behaviour of 9 species of spiders in maize crop in Delhi. Biswas & Biswas (1997) listed 10 species of spiders recorded from different places of Delhi. In the present century, Tanasevitch (2011) recorded *Microbathyphantes palmarius* (Marples, 1955) from New Delhi. In recent years, Malik *et al.* (2015, 2016a, b, 2017, 2018), Vidhel *et al.* (2015) and Diksha *et al.* (2018) recorded 31 more species of spiders from different localities of Delhi.

In the present compilation, a total of 53 species described under 43 genera belonging to 18 families were enlisted that have been described/recorded from different districts of Delhi giving current information in the light of existing taxonomic perception (Table 5). Out of 11 districts of Delhi, most of the spiders were recorded from South West Delhi (28 species) followed by New Delhi (15 species), East Delhi (8 species),

South Delhi (7 species), South East Delhi (5 species), West Delhi (3 species), and North and North East Delhi districts (1 species each). No spider was so far recorded from 3 districts of Delhi (Central delhi, North West Delhi, Shahdara) (Fig. 5). Hence, intensive and extensive faunal survey is required in these areas as spiders are very common and found every where.

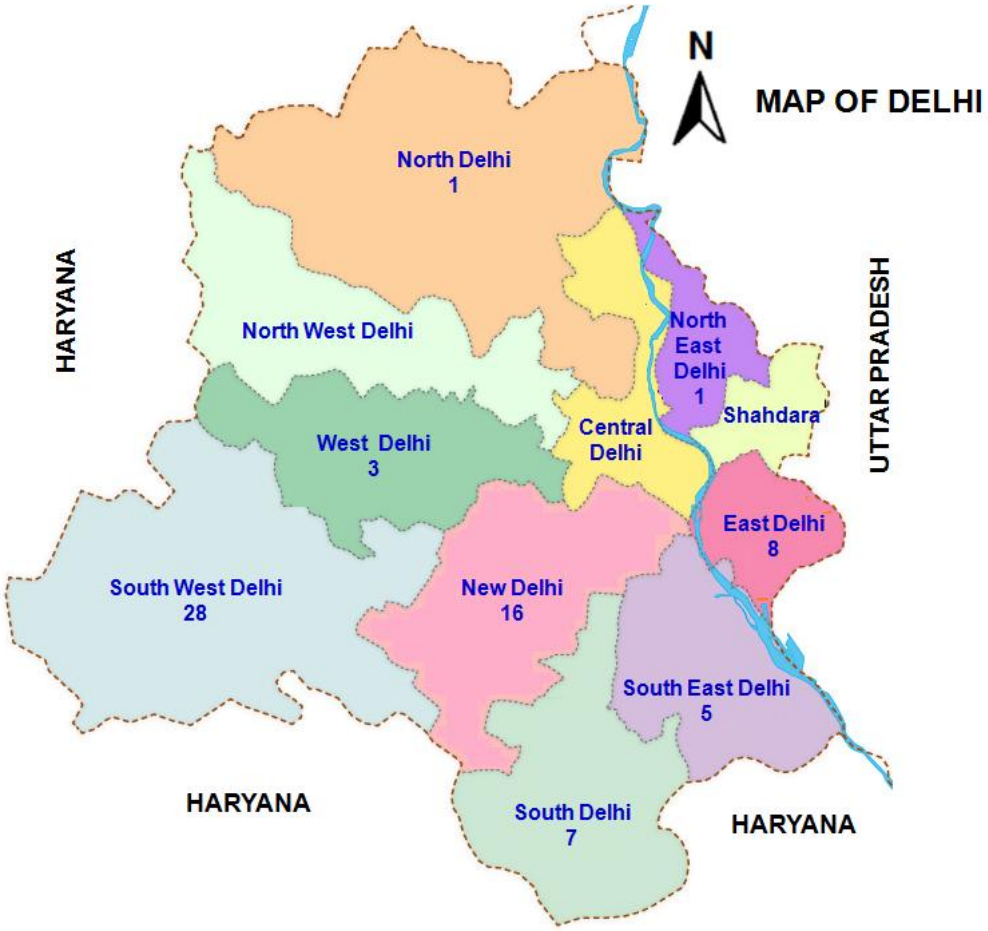

Fig. 5. Map of Delhi showing the number of species of spiders described/recorded from different districts.

Following is the list of species of spiders recorded/described from different districts of Delhi.

Table 5. Checklist of fauna of spiders described/recorded in different districts of Delhi.

Families/Species	Districts	References
1. Araneidae		
Araneus mitificus (Simon, 1886)	South West Delhi	Malik *et al.*, 2015
Argiope pulchella Thorell, 1881	South East Delhi	Biswas & Biswas, 1997
Cyclosa hexatuberculata Tikader, 1982	South West Delhi	Malik *et al.*, 2015
Cyclosa insulana (Costa, 1834)	New Delhi	Sharma & Sarup, 1980
Eriovixia excelsa (Simon, 1889)	South Delhi; South West Delhi	Malik *et al.*, 2015
Gasteracantha sp.	South Delhi	Malik *et al.*, 2015

Gibbaranea bituberculata (Walckenaer, 1802)	South West Delhi	Malik *et al.*, 2015
Larinia chloris (Savigny, 1825)	South West Delhi	Malik *et al.*, 2015
Neoscona sinhagadensis (Tikader, 1975)	New Delhi	Sharma & Sarup, 1980
Neoscona theisi (Walckenaer, 1841)	South West Delhi	Biswas & Biswas, 1997
Neoscona vigilans (Blackwall, 1865)	South West Delhi	Malik *et al.*, 2015
2. Cheiracanthiidae		
Cheiracanthium sp.	New Delhi	Sharma & Sarup, 1980
3. Clubionidae		
Clubiona drassodes O. Pickard-Cambridge, 1874	East Delhi; South West Delhi	Malik *et al.*, 2015
4. Corinnidae		
Castianeira sp.	New Delhi	Sharma & Sarup, 1980
5. Eresidae		
Stegodyphus pacificus Pocock, 1900	South West Delhi	Malik *et al.*, 2015
6. Gnaphosidae		
Drassodes delicatus (Blackwall, 1867)	New Delhi	Blackwall, 1867
Zelotes sajali Tikader & Gajbe, 1979	New Delhi	Biswas & Biswas, 1997
7. Hersiliidae		
Hersilia savignyi Lucas, 1836	East Delhi; South Delhi; South West Delhi; West Delhi	Malik *et al.*, 2015
8. Linyphiidae		
Microbathyphantes palmarius (Marples, 1955)	New Delhi	Tanasevitch, 2011
9. Lycosidae		
Hippasa greenalliae (Blackwall, 1867)	New Delhi	Blackwall, 1867
Hippasa lycosina Pocock, 1900	South West Delhi	Malik *et al.*, 2015
Lycosa carmichaeli Gravely, 1924	West Delhi	Biswas & Biswas, 1997
Lycosa iranii Pocock, 1901	South West Delhi	Malik *et al.*, 2015
Lycosa poonaensis Tikader & Malhotra, 1980	North Delhi	Biswas & Biswas, 1997
Lycosa prolifica Pocock, 1901	South Delhi	Biswas & Biswas, 1997
Pardosa sp.	New Delhi	Sharma & Sarup, 1980
Wadicosa fidelis (O. Pickard-Cambridge, 1872)	South West Delhi	Malik *et al.*, 2015
10. Oecobiidae		
Oecobius sp.	West Delhi	Malik *et al.*, 2015
Uroctea thaleri Rheims, Santos & van Harten, 2007	South West Delhi	Malik *et al.*, 2017
11. Oxyopidae		
Oxyopes bharatae Gajbe, 1999	East Delhi; South West Delhi	Malik *et al.*, 2015, 2016a
Oxyopes pandae Tikader, 1969	New Delhi	Sharma & Sarup, 1980

Peucetia akwadaensis Patel, 1978	East Delhi; South West Delhi	Malik *et al.*, 2015
12. Pholcidae		
Crossopriza lyoni (Blackwall, 1867)	New Delhi; South East Delhi	Blackwall, 1897; Biswas & Biswas, 1997
13. Salticidae		
Harmochirus brachiatus (Thorell, 1877)	East Delhi; South West Delhi	Malik *et al.*, 2015
Myrmaplata plataleoides (O. Pickard-Cambridge, 1869)	New Delhi	Sharma & Sarup, 1980
Phintella vittata (C.L. Koch, 1846)	New Delhi	Sharma & Sarup, 1980
Plexippus paykulli (Audouin, 1825)	South Delhi	Biswas & Biswas, 1997
Rudakius ludhianaensis (Tikader, 1974)	East Delhi; South Delhi; South West Delhi	Malik *et al.*, 2015
Stenaelurillus jagannathae Das, Malik & Vidhel, 2015	South East Delhi	Vidhel *et al.*, 2015
Thyene imperialis (Rossi, 1846)	East Delhi; South Delhi; South West Delhi	Malik *et al.*, 2015
14. Scytodidae		
Scytodes sp.	South West Delhi	Malik *et al.*, 2015
15. Sparassidae		
Olios tener (Thorell, 1891)	South West Delhi	Malik *et al.*, 2015
16. Tetragnathidae		
Leucauge celebesiana (Walckenaer, 1841)	New Delhi	Biswas & Biswas, 1997
Leucauge decorata (Blackwall, 1864)	New Delhi; South East Delhi	Sharma & Sarup, 1980
Tetragnatha andamanensis Tikader, 1977	North East Delhi	Biswas & Biswas, 1997
17. Theridiidae		
Argyrodes bonadea (Karsch, 1881)	South West Delhi	Malik *et al.*, 2015
Parasteatoda kompirensis (Bösenberg & Strand, 1906)	South West Delhi	Malik *et al.*, 2018
Phycosoma altum (Keyserling, 1886)	South East Delhi	Malik *et al.*, 2016b
18. Thomisidae		
Camaricus formosus Thorell, 1887	South West Delhi	Malik *et al.*, 2015
Monaeses parvati Tikader, 1963	South West Delhi	Malik *et al.*, 2015
Oxytate elongata (Tikader, 1980)	South West Delhi	Malik *et al.*, 2015
Thomisus andamanensis Tikader, 1980	East Delhi; South West Delhi	Malik *et al.*, 2015
Thomisus unidentatus Dippenaar-Schoeman & van Harten, 2007	South West Delhi	Diksha *et al.*, 2018

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The first record of *Rothus aethiopicus* (Pavesi, 1883) (Araneae: Pisauridae) in Egypt and North Africa

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Abstract

The pisaurid spider species *Rothus aethiopicus* (Pavesi, 1883) is recorded for the first time from Egypt and North Africa. The general habitus and genitalia of both male and female are illustrated. Description and collecting data of this species are also given.

Keywords: Araneae, Pisauridae, *Rothus aethiopicus*, new record, Egypt.

Introduction

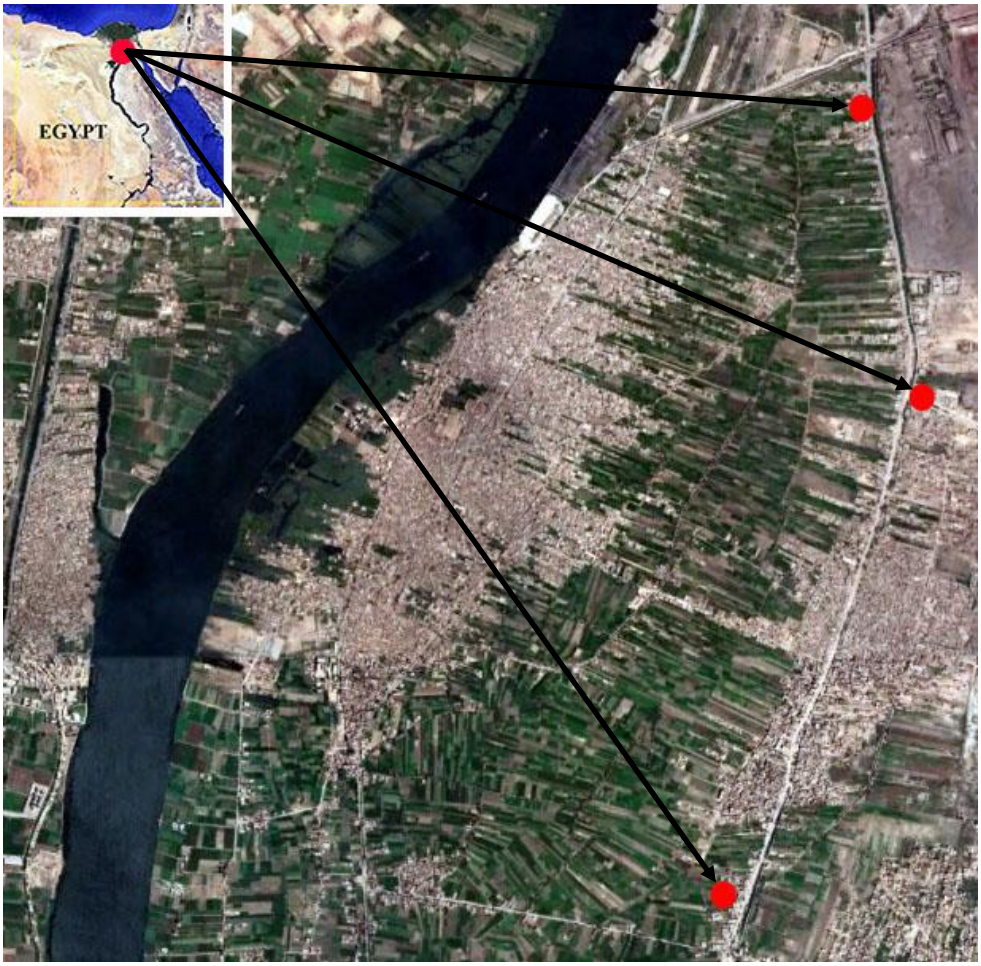
Among the 51 genera of family Pisauridae Simon, 1890 (354 species), genus *Rothus* Simon, 1898 is a small genus including only 3 species (World Spider Catalog, 2021): *Rothus aethiopicus* (Pavesi, 1883), *R. vittatus* Simon, 1898, and *R. auratus* Pocock, 1900. Both *R. vittatus* and *R. auratus* are known only from South Africa and they may be conspecific (Silva & Sierwald, 2015). *Rothus aethiopicus* is known from Eritrea, Ethiopia, "widely distributed in Africa south of the Sahara: Senegal to Kenya, southwards including Zambia, Zimbabwe, Namibia and South Africa" (Silva & Sierwald, 2015), and is recorded from Palestine/Israel too (Levy, 1999).

Family Pisauridae is represented in the Egyptian fauna by 4 species of 4 genera (El-Hennawy, 2017): *Dolomedes hyppomene* Savigny, 1825 from Damietta; *Nilus curtus* O. Pickard-Cambridge, 1876 from Alexandria; *Pisaura mirabilis* (Clerck, 1757) [Unknown locality]; and *Rothus atlanticus* Simon, 1898 ? from Siwa Oasis.

Genus *Rothus* is represented in Egypt by 1 species: *Rothus atlanticus* Simon, 1898 ? from Siwa Oasis. Denis (1947) reported 4 juveniles collected in August from Siwa and identified them as "*Rothus atlanticus* Simon, 1898 ?". Simon (1898) described *R. atlanticus* depending on juvenile (pullus) ♀ from Algeria and Tunisia. Blandin (1977) examined Simon's material and stated that they are "7 juveniles from Gabès, Tunisia" and

that Denis' specimens are also juveniles. Therefore, *Rothus atlanticus* is considered a *Nomen dubium* by Blandin (1977) and World Spider Catalog (2021). The record of *Rothus atlanticus* from Siwa is not valid but it is still reasonable for recording the genus *Rothus* from Egypt.

Males and females of *Rothus aethiopicus* (Pavesi, 1883) were found running on ground and were collected by hand from the industrial area of Al-Tebbin region in Helwan, Cairo governorate, Egypt. "The study area was located east of the River Nile, 20 km south of Cairo, in Al-Tebbin region in the Helwan Province. ... it is considered the biggest industrial zone in Egypt, with about 16.5% of the total industrial activities for the country. The main industrial activities include ferrous and nonferrous metallurgical work, coke factory, chemical and cement industry. ... With the steady increase of industrial emissions, in addition to high temperatures, lack of rain, and predominantly low wind speed, this area has severe air pollution problems" (Soliman & El-Shazly, 2017). Spiders were collected from three locations east of the River Nile (1.1 - 2.0 - 2.43 km east of the Nile). The three locations included sporadic cultivated areas and buildings (Map 1).



Map 1. Collecting sites in the industrial area of Al-Tebbin region in Helwan, Cairo governorate, Egypt.

Abbreviations used: AL = abdomen length, ALE = anterior lateral eye, AME = anterior median eye, CL = cephalothorax length, CW = cephalothorax width, Fe = femur, Mt = metatarsus, Pa = patella, Ta = tarsus, Ti = tibia, PLE = posterior lateral eye, PME = posterior median eye, TL = total length. All measurements are in millimetres (mm).

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Figs. 1-8. *Rothus aethiopicus* (Pavesi, 1883) ♂♂, habitus, different views.

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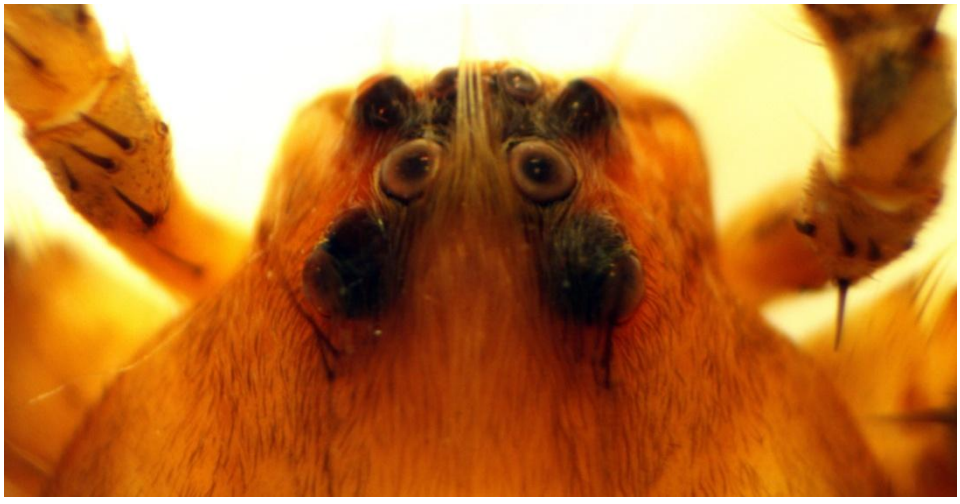
Figs. 9-10. *Rothus aethiopicus* (Pavesi, 1883) ♀, habitus, dorsal and ventral views.

11   12

13 

Figs. 11-13. *Rothus aethiopicus* (Pavesi, 1883), cephalothorax, dorsal view. 11. ♀. 12-13. ♂. 13. eyes.

Taxonomic treatment

Family **Pisauridae** Simon, 1890
Genus ***Rothus*** Simon, 1898

Rothus aethiopicus (Pavesi, 1883)
(Figs. 2-20)

Synonyms (World Spider Catalog, 2021):
Ocyale aethiopicus Pavesi, 1883: 71 (D♂♀).
Rothus purpurissatus Simon, 1898a: 294, f. 293-294, 298 (F-G, K); Simon, 1898b: 14 (D♀); Blandin, 1976: 918, f. 5-6 (♀); Blandin, 1977: 552, f. 10-12, 15-27, 31 (♀, S♂); Levy, 1999: 60, f. 34A-B, 35A-B (♂♀).
Rothus catenulatus Simon, 1898b: 15 (D♀); Caporiacco, 1940c: 786, f. 8 (♀).
Rothus lineatus Pocock, 1902: 16, pl. 3, f. 2 (D♀).
Rothus aethiopicus Simon, 1907: 8 (T♂♀ from *Ocyale*); Lessert, 1916: 581, f. 15-18 (♂♀); Roewer, 1955: 206, f. 79a-e (♂♀); Blandin, 1977: 552 (*nomen dubium*); Silva & Sierwald, 2015: 327, f. 2-23 (♂♀, removed from *nomen dubium*, S).
Rothus magnus Caporiacco, 1940: 784, f. 7 (D♂♀); Blandin, 1977: 552 (*nomen dubium*).
Rothus upembanus Roewer, 1955: 209, f. 80a-b (D♀).
Rothus pictus Roewer, 1955: 210, f. 81a-e (D♂♀).
Rothus mossamedesus Roewer, 1955: 214, f. 82a-b (D♀).
Rothus vestitus Roewer, 1955: 217, f. 83a-b (D♀).

Material examined: 6♂♂, 3♀♀, Egypt, Cairo governorate, industrial area of Al-Tebbin region in Helwan south of Cairo, from 3 locations (29º45.828'N, 31º17.941'E, elevation 23m; 29º45.204'N, 31º18.071'E, elevation 22m; 29º44.073'N, 31º17.554'E, elevation 21m), leg. Mustafa M. Soliman, June 2019.

Description
Colouration: preserved specimens are almost light brown with lighter bands and darker patches (Figs. 1-10). Anterior eye row straight, posterior row strongly recurved, slightly wider than anterior row, and posterior eyes are larger than anterior ones (Figs. 11-13).

Female
Measurements (n=4): TL 14.0, 14.9, 16.9, 19.0; Average 16.2

♀ TL 14.0, CL 5.8, CW 4.7, AL 8.2, CL/CW 1.23
Eye diameters and interdistances: AME 0.22, ALE 0.26, PME 0.41, PLE 0.41; AME–AME 0.24, AME–ALE 0.24, PME–PME 0.36, PME–PLE 0.48, AME–PME 0.33, ALE–ALE 1.08, PLE–PLE 1.51, ALE–PLE 0.96.

Table 1**.** Measurements of leg segments of *Rothus aethiopicus* ♀.

Legs	Fe	Pa	Ti	Mt	Ta *	TL
I	6.3	2.5	6.1	6.1	3.1	24.1
II	6.3	2.6	5.8	5.9	3.1	23.7
III	5.9	2.2	4.7	5.3	2.3	20.4
IV	6.8	2.3	5.9	7.3	2.6	24.9

Leg formula: 4-1-2-3 *= excluding claws

Female epigynum as in Figs. (14-16).

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Figs. 14-16. *Rothus aethiopicus* (Pavesi, 1883) ♀, epigynum. 14-15. ventral view. 16. dorsal view. 15-16. cleared.

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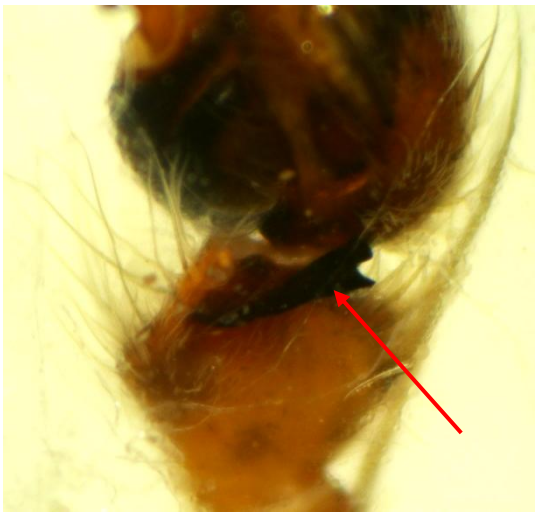 20

Figs. 17-20. *Rothus aethiopicus* (Pavesi, 1883) ♂, palp. 17. prolateral view. 18. ventral view. 19. retrolateral view. 20. retrolateral tibial apophysis (red arrow).

Male
Measurements (n=6): TL 12.1, 12.4, 12.6, 13.9, 14.5, 14.9; Average 13.4

♂ TL 12.1, CL 5.8, CW 4.5, AL 6.3, CL/CW 1.29

Eye diameters and interdistances: AME 0.26, ALE 0.29, PME 0.34, PLE 0.34; AME–AME 0.13, AME–ALE 0.19, PME–PME 0.36, PME–PLE 0.48, AME–PME 0.31, ALE–ALE 0.86, PLE–PLE 1.44, ALE–PLE 0.86.

Table 2**.** Measurements of leg segments of *Rothus aethiopicus* ♂.

Legs	Fe	Pa	Ti	Mt	Ta *	TL
I	6.8	2.6	6.8	6.8	3.9	26.9
II	6.8	2.4	6.3	6.8	3.6	25.9
III	5.9	2.1	5.2	6.1	2.3	21.6
IV	7.4	2.1	6.1	7.7	3.0	26.3

Leg formula: 1-4-2-3 *= excluding claws

Male palp as in Figs. (17-20).

Distribution: The African pisaurid *Rothus aethiopicus* is mainly recorded from East and South Africa with a single exception from Senegal in west Africa (Silva & Sierwald, 2015: f. 1). This new record from Egypt broadens the distribution range of *R. aethiopicus* towards the north taking in consideration that juvenile spiders of genus *Rothus* are already known from North Africa (Egypt, Algeria and Tunisia) as mentioned before.

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